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Electrical World

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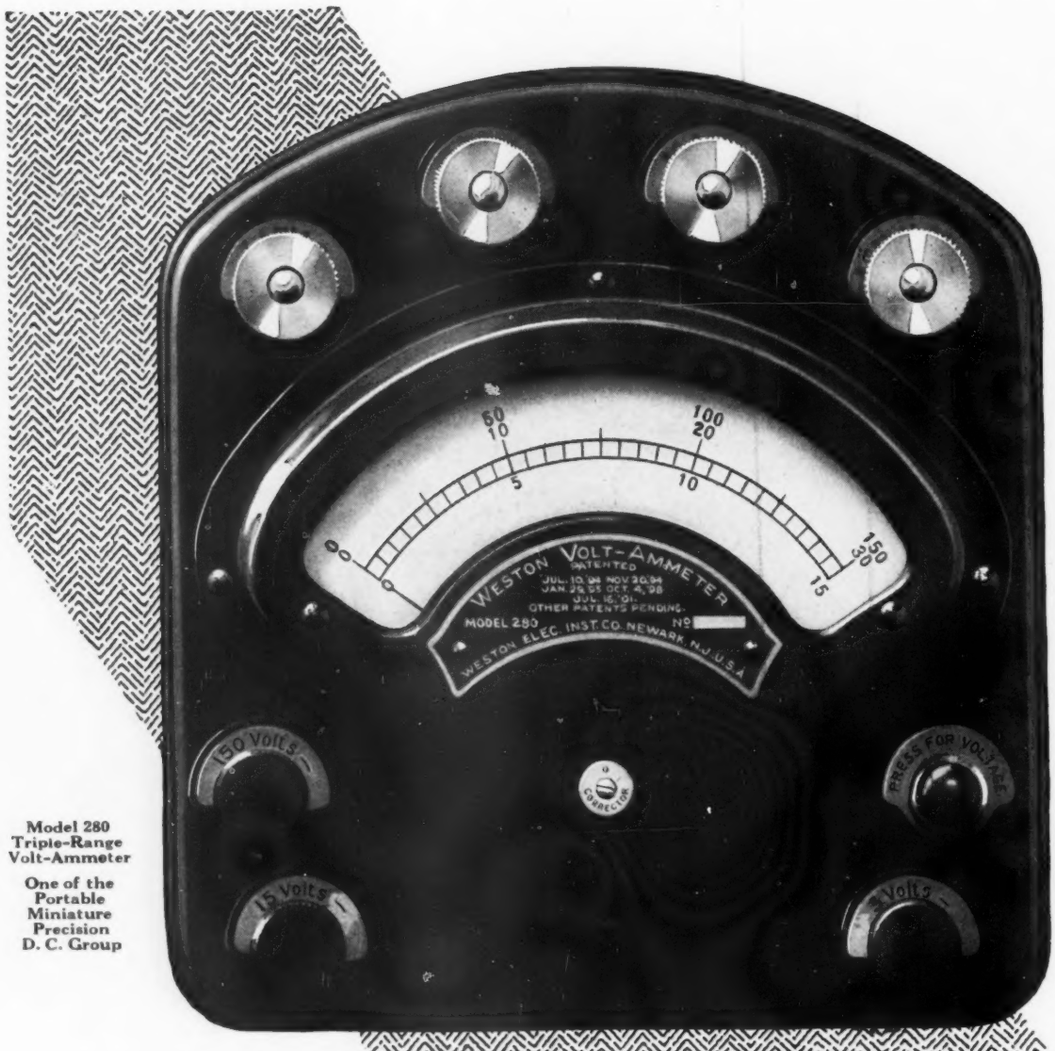

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Daylight Saving Doomed

THE advantages of daylight saving are many and its advocates have advertised them far and wide; its disadvantages are, however, fast becoming known, and as a result the daylight-saving law ought to be, and in all probability will be, repealed at the present session of Congress. The claim that the electric and gas utilities are the mainstay of the opposition against the measure is false. That these utilities have suffered monetary loss because of daylight saving is a fact, but they bore the loss with good grace, knowing that it is futile to oppose any movement for the public good. A fair trial shows that the disadvantages of daylight saving outweigh its advantages. Farmers are bitterly opposed to its continuance, and the American Federation of Labor is apathetic to resolutions protesting against its repeal. With such opposition the law is doomed, and the electric utilities can look forward to regaining the increment of income which the law wrested from them.

When, in the future, we glance back over our use of our opportunities, what will the electrical industry say of itself? Is it looking carefully to the open doors of conservation, centralization of resources and interconnection, and will it take every chance for progress that the law and economics present?

The Obligation to Help

IT IS generally recognized that the commerce of today and to-morrow will be predicated on international intercourse. Intelligent self-interest, therefore, dictates that the American electrical industry should become international in viewpoint if not in scope. As every lover of pure science knows, wisdom and truth have no national barriers, and unless we profit from the skill, knowledge and experience of others, our development both nationally and individually is retarded. If, therefore, the world is to advance and humanity to be benefited, all departments of scientific thought and action must be coördinated, technics and economics must be studied together and individual efforts directed for the general good of all. There are three lines along which development can take place—financial, industrial and educational—and while we in the United States possess besides great wealth the ability to build super-organizations, we still lack the incentive to delve deeply into the hidden mysteries of science from the purely educational motives which have dominated our European brothers. From them and their progenitors we have learned much—ay, the electrical industry in particular is indebted to Europeans in greater measure than many are conscious of. It behooves it, therefore, to take cognizance of its obligations to European science and to repay the debt as promptly and as well as it can. Italy, France and England are at present backward in electrical applications, yet Italy gave the world Volta and Galvani, France contributed Coulomb, Ampère and Foucault, and England raised Faraday, Maxwell, Kelvin and a host of others, to all of whom electrical science is indebted. American skill and ingenuity as well as American capital can be utilized in developing the hydroelectric resources of Europe, in erecting superstations and high-tension transmission lines and in the operation of vast interconnected systems, because it is along these lines that American electrical engineers are particularly adept. European wants in this regard are pressing, and the response of the American electrical industry to these needs should be prompt and generous.

Bituminous coal production has improved a little from the low level reached a short time ago. Central-station companies naturally are reluctant to maintain large reserve stocks at high prices but they cannot escape the obligation to provide safeguards for continuous service. The coal situation is not yet stabilized.

Problems of Supervoltage Transmission

THE study by A. E. Silver of the possibilities of power transmission at a voltage hitherto untried, as presented in a paper read before the A. I. E. E. this week and abstracted elsewhere in this issue, is well worth careful consideration. The coming of long-distance power supply from coal fields and hydroelectric stations in immense quantities raises new questions of economy. Present voltages ranging to 150,000 have proved thoroughly workable, and the obvious step is to still higher figures to reduce the cost of conductors. General experience has been that the anticipated difficulties of increasing voltage have been greatly overestimated, like those apprehended from increased length of lines, so that Mr. Silver's proposition of 220,000 volts will hardly cause the raising of an eyebrow, so far as its practicability is concerned. As a mere engineering feat there is little doubt of success, for transformers for this pressure have already been constructed and the proper arrangement of suspension insulators for the line insulation is fully determined from experience now at hand. The unknown factors in the case are the reliability of the transformers in continued use, the adequacy of the necessary switching devices and the maintenance of the lines under the untried stresses which must be dealt with.

As to transformers, the situation is somewhat relieved by the fact that they would be of very great capacity, since 220,000-volt working would not be justified save for large amounts of power demanding large units. But

no one now knows how well existing transformer insulation will stand the greatly increased dielectric stresses for twenty-four hours a day all the year. The transformers already built for extreme voltages have been mainly of the testing class used discontinuously or for comparatively short experimental runs, and their endurance at full load is as yet undetermined. It is not a question of possibility, for our transformer designers can be trusted eventually to meet the requirements, but merely whether or not a new scheme of insulation must be devised and what the product will cost in original outlay and maintenance. Other things being equal in the operative sense, line copper is an investment of more permanent character than apparatus, and the total annual charge as respects both is the thing to be considered. Of the apparatus required, the switching outfit is second only to the transformers. It becomes a rather formidable proposition at 220,000 volts, perhaps best met by switching as far as possible on the low-voltage side and regarding the transformers as part of the line, not of the generating plant. There is no reason why overload or out-of-balance relays should not clear the lines on the low-voltage side when trouble of a serious kind occurs, especially since in an important transmission project the circuits would certainly be in duplicate.

As to the upkeep of the lines, only experience can furnish even an estimate. At an extreme voltage like that proposed there are new elements to be considered. The magnitude and effect of the corona losses must be taken into account, and since the lines involved will be both exceptionally long and heavily loaded, the possibilities of surging and allied phenomena take on an importance not heretofore realized. Protection against lightning too may require considerable specialization on account of the extremely high normal stresses and resulting impairment of the factors of safety. On these matters of upkeep hinge the economics of the situation. As a matter of fact, the conditions that clearly call for a large increase of working voltages are as yet very rare. They will become common only as very large output must be transmitted over distances now unusual. And even so, the matter of necessary interconnection introduces practical difficulties since in a complete development many plants of moderate size must be taken into account in which very high voltage loses its economic advantage. We are inclined to think that the rôle of voltages of 200,000 and more is likely to be in the constitution of linkage networks, comparatively simple, interconnecting a few very large plants at suitable places with the main working network fed by stations of moderate capacity like most hydroelectric installations. When the need of sending several hundred thousand horsepower a few hundred miles actually arises we have little doubt that the voltage will be appropriately raised, and with operative success; but there is much yet to be learned about the practical economics of the situation. The first try-out should be on no colossal scale, but directly toward the determination of transformer and line endurance under conditions readily permitting dropping back to more conservative figures if need be, pending further experimentation. The whole history of power transmission furnishes one encouragement for the future. It is but five and twenty years since the sole 10,000-volt plant in our country was operating with twenty 500-volt transformers in series to obtain its superlative line voltage. Every uplift since then has met its reward.

International World Trade Conditions

MANUFACTURERS of electrical supplies have two purposes in their study of international trade conditions. One is to prepare to present to Congress data in connection with the tariff on the classes of products that they make; the other is to furnish information and advice about export markets. In their study of the tariff situation the manufacturers of electrical supplies are coöperating with the manufacturers of electrical apparatus (including generators, motors and control apparatus) so that the lines of inquiry are similar; and in the investigation of export markets substantial assistance is promised through the proposed organization or association to undertake research work in this direction. These matters were considered in some detail at one of the sessions of the Associated Manufacturers of Electrical Supplies at New London, Conn., as reported in last week's issue of the ELECTRICAL WORLD. They are all vital issues to the electrical manufacturers, and it is to be earnestly hoped that full support will be given to the various movements of this character so that all of the facts may be made perfectly clear. The electrical industry, like other industries, is completely in the dark as to just what international conditions will have to be faced. Day by day we are brought to a keener realization of the changes of war. Old currents of world trade are diverted and no one can tell just where and how they will run in the future. The industry is bound up with the international policies of the whole country. Economics and the trade relations of nation to nation will be large subjects which will require the best thought of the industry for a long time. Coördination of all effort in the investigation of international trade conditions and careful searching for the facts before any action is taken will be important. These measures will surely guide the electrical industry to a position in accord with the national policies. Necessarily it will be a question of a long period before the world future conditions can be seen, and no certain conclusions can be expected until they are more clearly defined.

It is when needed commodities become scarce that the world appraises their value highly. Just now this is the great fact on food. Yet we go blindly forward consuming our fuel resources, and the future years and generations will find us guilty of criminal waste of water power.

The Use of Protective Relays

AN EXTREMELY useful résumé of current practice in the application of protective relays to the operation of lines was presented before the American Institute of Electrical Engineers Wednesday by Messrs. Woodrow, Roper, Travers and MacGahan and is covered quite fully in this issue. In the beginning most central stations started out with a substantially radial system of feeders protected by current-limiting devices at the station. As the requirements of distribution grew this simple arrangement soon passed the limits of its usefulness, and steps had to be taken to prevent serious disturbance of the service by faults in the ever-increasing complex system of distribution. More particularly did extra protection become necessary when the radial systems were involved in networks, interlinking in various ways the feeders from the station, and when substa-

tions in course of time were added operating in multiple with the original source of energy. The evolution of networks is a necessary part of modern distribution systems. A radial plan of operation in the long run involves very wasteful use of copper, bad enough at all times, extremely serious when the distribution is underground. The wandering of the load at different periods, a subject which even now has been very insufficiently studied, makes necessary for sake of economy network connections between parts of the system, which must now be considered almost universally as an interconnected whole.

Hence has grown up the use of protective relays so thoroughly studied by the authors of the paper in hand. The commonest and most generally used scheme of protection is that of inverse-time relays set for different periods of action so that in case of a short circuit or other extraordinary demand the relay system will not fall like a row of bricks, involving large areas in loss of service, but will act selectively, catching the overload in such wise as to segregate only the region immediately affected. In a comparatively simple distribution system such a plan can be carried out very effectively if the relays—and this is a point on which the authors lay stress—are systematically tested and set to the requirements of the existing situation. As networks grow, however, something more is necessary, and the most important development has been in directional relays, often referred to as reverse-power relays, which prevent particularly the serious interference of substations.

To these simple applications there have been added from time to time others, many of which are familiar, controlling abnormal increase or decrease of current, voltage, watts or frequency. And these instruments exist in various combinations and modifications concerning which the authors have something to say. It is perhaps worth while directing special attention to one composite form in which the under-voltage and over-current principles are combined. This arrangement at times is of large practical value.

Beyond these are still another group of protective devices depending on the balance between the currents in different circuits or at different points of the same circuit. These involve, when the scheme is thoroughly carried out, duplicate lines in parallel, split-conductor cables or cables with pilot wires, all of which have been successfully applied. So far as present practice goes, no one general system has found its way into very extensive use when one passes beyond the rudimentary necessities of a simple distribution. As complex networks have grown up the treatment of these safety precautions has necessarily been somewhat symptomatic, various devices being used as and where they promised good results.

If one could start out afresh and develop the distribution lines for a large central station, some unified system of line protection, quite likely on the balance principle, could be worked out to its logical end. As things are, the aggregate of the necessities which have arisen from time to time have compelled dealing with conditions as they are, which accounts for the very diverse practice now to be found. The authors of this paper have outlined the situation as it exists in an extremely useful and practical way, and station operators will find their study of the situation very much to the point.

Foreign Transmission Projects

THE stress of war, with the accompanying disorganization of the coal supply, has had a most powerful influence in arousing new interest in projects for general power supply, whether from steam or hydroelectric stations. When it is realized that a sudden stroke of war may entirely demoralize the transportation upon which fuel supply depends, the necessity of such steps is sufficiently obvious. Particularly is it so since the next war is likely to break out without a word of warning, the aggressor depending on the effectiveness of a sudden stroke delivered before the slow and creaking machinery of loosely organized alliances may find time to rouse resistance.

Two countries in particular may be mentioned as making vigorous efforts toward improvement of the electrical supply—the one England, formulating a broad plan of correlation for electrical enterprises; the other Japan, at the further side of the world, rising to the development of the unutilized water powers with a well-worked-out project for a general survey. We have described already at some length (in the June 7 and 14 issues) the English plans, which are directed toward the formation of district boards with plenary powers able to undertake on a large scale the provision of electric power, with due guard placed over the rights of existing private enterprises, and toward general coöperation among the superstations for power supply which have already been projected. From necessity England must depend very largely on generating stations placed at or very near cheap coal supply, her hydroelectric possibilities being somewhat limited.

Japan, on the other hand, is rich in water powers. About 1,000,000 hp. is now developed by hydroelectric stations; double this amount is under lease for exploitation, while about 5,000,000 hp. remains undeveloped and unsurveyed. The project of investigation for the Japanese government is a very comprehensive one. It includes the coöperation of twenty-two survey parties which are examining more than 300 streams and double that number of power sites, aggregating more than 5,000,000 hp. Three hundred and twenty gaging stations and more than 700 points of observation of rainfall and other phenomena are to be established, so that a great mass of precise information will be available to guide the future developments. No power site of less than 1000 hp. will be considered at present. In studying the possibilities of flow two classes of observing stations are made use of, one merely recording the quantities of rain and snow, the other, more fully equipped, in addition keeping records of evaporation and temperature. Between the two it should be possible in a very few years to get a much better idea of the real available resources than has usually been attainable.

In our own country comparatively few streams have been studied in a way sufficiently comprehensive to give at once information as to the flow and also as to the conditions which affect run-off. We have, it is true, large projects for universal power systems under consideration, but there is lacking as a rule the correlated effort and the unification of authority necessary to make them genuinely effective. The war has brought home to us the need of coördinated action in developing the great power resources of the country, and the vital question for the future is whether we shall forget this, like other lessons of the war, or shall drive ahead to obtain the benefits which are in sight.

220,000-Volt Transmission an Immediate Possibility

Especially Adapted to Bringing Large Blocks of Power from Coal Mines and Water Powers to Industrial Markets—Technical Problems Not Serious—Some Research Necessary

THE dependence of industrial progress upon an adequate supply of electrical power, together with the vital need for a rational policy of conservation of the country's fuel resources, points to a probable early demand for transmission of large blocks of power from distant energy sources—coal fields and water powers. In the opinion of A. E. Silver, Electric Bond & Share Company, who presented an elaborate paper before the American Institute of Electrical Engineers at Lake Placid, N. Y., last Wednesday, 220 kilovolts is a logical voltage for such high capacity, long-distance transmission. Immediate adoption of this voltage is commercially feasible, he said, if established principles of design and present types of equipment are adapted to the new conditions. Current-design principles and materials now in ordinary use will be employed, the principal difference from present high-voltage equipment being the greater amounts of insulation and the larger clearances required. While all essential problems seem assured of solution, Mr. Silver directed attention to certain points which need further investigation and experimental research in order to determine the most effective designs. In doing so the important problems introduced by large concentrations of power, high voltage and high-service standards were discussed and several general designs considered as a basis for an economic study. Some of the features of his paper follow.

220 Kv. Adequate for Pending Needs

Two hundred and twenty kilovolts appears to be a logical voltage for the next step in transmission development because it is considered adequate for the pending needs of the industry and is commensurate with expected growth in transmission service for a considerable period. Such an advance in voltage would afford a distinct economic advantage and does not reach so far into uninvestigated fields but that the problems of development and design can be approached with full confidence of early commercial solution. Furthermore, this voltage is a multiple of 11,000 and 110,000. The advantages of 220 kv. over 150 kv. are shown by Figs. 1 and 2, which are based on a transmitted load of 500,000 kw. The same relative advantage will apply for larger loads and above a certain minimum for smaller loads.

The economic application of 220 kv. is primarily limited to the transmission of large blocks of power over considerable distances. It presumably will infringe to some extent upon present fields of lower transmission voltages, but will by no means supersede their use. It is not universally suitable for extensive interconnection of power systems. Interconnection at 220 kv. would be expected only where the equalizing duty reaches a great magnitude, where there is no existing secondary transmission system suitable to serve as a basis for interconnecting lines, or where interconnecting 220-kv. lines might function also as a supplementary or reserve link in a main 220-kv. trunk transmission system.

The initial investment in a 220-kv. transmission system, including as essentials the step-up and step-down stations, will be of such magnitude that there will be a strong inducement to utilize the investment as nearly continuously as practicable, thus reducing the unit transmission cost of energy supplied. Hence the tendency in introducing this voltage will be to supply base load, leaving peak loads to existing local generating stations. In view of the volume of industrial enterprises and public utilities which would be dependent on 220-kv. transmission, reliability and continuity of power supply would be of such a high order that new standards of care in design and conservation in construction would be necessary.

In arriving at his conclusions, some of which are presented here, Mr. Silver assumed that load per 220-kv. circuit would be from 100,000 kw. to 125,000 kw. A lower load would entail a considerable sacrifice of economy. No discussion is offered as to the maximum economic load per circuit since in any initial system the number of circuits would be determined by reliability insurance or load distribution rather than by maximum inherent economy. The economic transmission range of 220 kv. is very large, but for this study it has generally been assumed to be 250 miles (400) km.). A frequency of 60 cycles is considered best. Grounded Y-connections have a marked advantage for this voltage because of the distinct gain in dependability and the lower line and

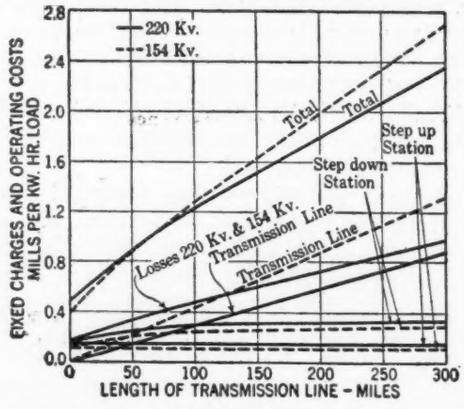


FIG. 1—ECONOMIC COMPARISON OF FIXED CHARGES AND OPERATING COSTS FOR 154-KV. AND 220-KV. TRANSMISSION LINES DELIVERING 500,000 KW.

Based on four 220-kv. circuits and seven 154-kv. circuits. Costs and losses include those of lines, step-up and step-down substations and synchronous condensers. Cost of line per mile: 154-kv., $20,000; 220-kv., $23,500 (early 1919 prices). Size of conductor, 92,900-circ.mil steel, 716,000-circ.mil aluminum. Losses based on 0.95 load factor and 0.85 power factor. Cost of energy, 5 mills per kw.-hr. Fixed charges and operating expenses of transmission lines, 13 per cent; substations, 15 per cent. Voltages on high side of transformers: Receiver end, 150 kv. and 200 kv. respectively; sending end, 170 kv. and 225 kv. respectively.

equipment insulation with their attendant effect upon size and cost of equipment.

For simultaneous conditions of conductor loading, used as a basis for design, the following were assumed: Wind pressure of 8 lb. per square foot of projected area, 1½ in. radial thickness of ice, and a temperature of zero deg. Fahr. Justification for these apparently extreme loads is found in the high service standards which are

demanded. Corona formation and loss enter as a significant factor at a voltage of 220 kv. so an average elevation of 1000 ft. (300 m), a storm factor of 12.5 per cent and a barometer (during storms) of 28.4 in. (71 cm.) were assumed.

Three commercially practicable types of conductors—aluminum with steel core, copper with steel core and all

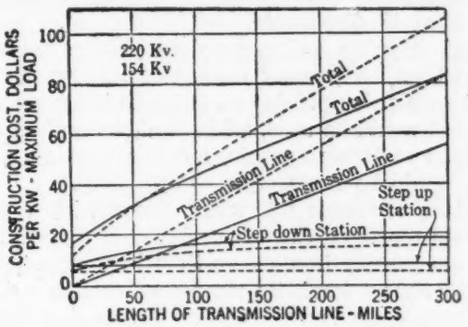


FIG. 2—ECONOMIC COMPARISON OF CONSTRUCTION COST FOR 150-KV. AND 220-KV. LINES (SEE FIG. 1)

copper—were considered. These may be compared as follows:

Aluminum steel versus copper steel:

1. Less corona loss, due to larger diameter.
2. Skin effect presumably approximately equal.
3. Greater area exposed to wind loading, hence greater transverse tower strength and greater clearances required.
4. Less tensile strength, hence more limitation upon height and spacing of towers.
5. Less weight (unimportant).

All-copper versus composite cable:

1. More corona, greater than either of above.
2. All material effective as a conductor.
3. Skin effect more serious in larger sizes, owing to high-priced material in the core.
4. Less area exposed to wind loading.
5. Less weight than copper steel.
7. Homogeneity of material, hence certain advantages in construction, more positive assurance of durability and higher scrap value.

For the purpose of developing tower designs a cable of 716,000 circ.mils of aluminum and 93,000 circ.mils of steel was used. Corona losses at various load factors are shown in Fig. 3, while the line characteristics for an aluminum-steel circuit are shown in Fig. 4. In the paper presented at Lake Placid the relative economy of various sizes and types of conductors was indicated graphically, but it is not reproduced here. It took into account interest, taxes and amortization charges and annual value of lost power. The curve falling lowest on the scale at any number of years which may be assumed as the life of the line represented the most economical conductor. If the life is considered to be about forty-eight years, the annual cost is about $200,000 for aluminum steel about 1 in. in diameter at 60 per cent load factor and from $400,000 to $450,000 for copper steel at the same load factor. At 90 per cent load factor the annual cost ranges from $575,000 to $630,000 for the copper steel and from $500,000 to $550,000 for the aluminum steel. While the total costs are higher for the higher load factors, the unit costs would be lower.

STRINGING COMPOSITE CONDUCTOR A PROBLEM

Within any limits thus far investigated, it appears economical, under the design loading assumed, to utilize the full strength of aluminum steel up to its elastic limit—*i.e.*, to keep sags to a minimum—thus enabling use of shorter towers or longer spans at the expense of stronger supporting structures at angles and dead-end points. With a new aluminum-steel cable, when the loading has been reached which will stress the steel core to its elastic limit, the aluminum will have passed its elastic limit and in consequence will be permanently stretched. As the heavy design loading is removed the aluminum strands will loosen infinitesimally on the steel core and take no stress. At lighter loadings the aluminum will be a dead load upon the steel core, which will carry all of the stress.

This difference in characteristics leads to the possibility of two different methods of stringing a composite cable—*i.e.*, it may be strung as received from the factory or it may be stressed, prior to sagging and tying in, to its full strength, 17,300 lb. (1211 kg. per sq. cm.), thus giving it nearly all of its "permanent set." (It would receive all of its "permanent set" if the stretching were done at zero deg. Fahr.). From the operating standpoint, however, it would seem preferable to string the cable without preliminary stretching. Possibly a combination of the two methods might be worked out whereby the cable would be stressed before tying in to some definite tension sufficient to insure giving the aluminum part of its "permanent" set.

Adequate splices for aluminum-steel cables no longer are considered to present a problem. In view of the

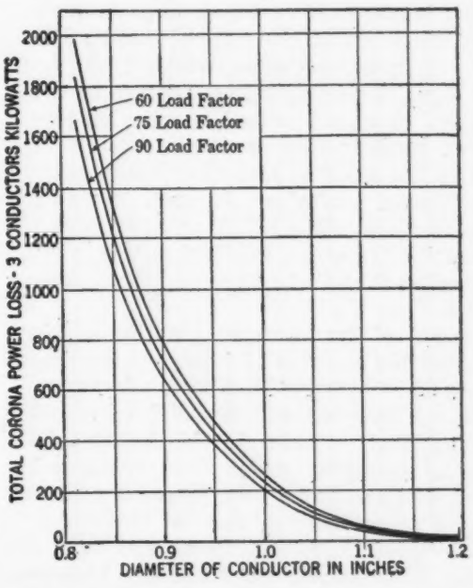


FIG. 3—CORONA POWER LOSS AT 220 KV. FOR 20-MILE CIRCUIT WITH GENERATING VOLTAGE HELD CONSTANT AT 230 KV.

The copper and copper-steel diameters considered range from 0.814 in. to 1.004 in., while the aluminum-steel diameters range from 0.952 in. to 1.196 in.

great importance of 220-kv. service it has been deemed conservative, until further experience is obtainable, to make provision for the use of ground wires.

There is no type of insulator as yet developed which has thus far demonstrated its ability to give adequate, or even reasonably satisfactory, results on high-voltage lines. Nevertheless, it is confidently believed that 220-kv. line insulation can, with existing types of insulators, be made as safe and dependable as can the line in-

sulation of present installations. The design suggested by Mr. Silver makes provision for a string of fifteen standard units for regular suspension service on a 220-kv. grounded neutral line. This relatively large number of units affords a considerable margin for deterioration and, with proper care in maintenance, should assure a degree of reliability in service commensurate with the economic importance of 220-kv. service.

It should be noted that a string of fifteen standard units, with the necessary connecting pieces and fittings, will be nearly 9 ft. (2.7 m.) long. Such a length of insulator obviously will involve great expense in obtaining the necessary tower clearances and heights, and it is also the determining feature in fixing conductor separation. This serves again to call attention to the need of more efficient and suitable insulators. An improvement in insulator design which would justify shortening the string, in addition to improving the electrical characteristics of the insulator itself, would enable material saving in tower costs. A wholly new insulator, having no greater length than necessary to insure requisite air clearances from conductor to support, say 4 ft. or 5 ft. (1.2 m. or 1.5 m.) would enable a correspondingly greater and a very significant saving in tower costs.

Two methods are recognized as offering relief from an excessive voltage gradient at the line end of the insulator strings. The first is the grading of the insulator units used in the string. This should be accomplished by making up the string of units of two or more distinct types, differing in size or diameter or in some other feature which would cause them to have different condenser capacities, those with the larger capacities being placed nearest to the conductor. A second method of relieving this excessive concentration of stress consists in installing below or around the disk nearest the conductor suitably designed metallic shields or rings. The effect of such shields in improving the stress gradient may be even more marked than that of grading the insulator units.

A feature of the insulator situation which complicates the question of voltage stress distribution and which will have some effect upon methods of carrying out remedial measures is the fact that, in order to obtain adequate mechanical strength, two or three strings of standard disks must be used in parallel at suspension points and proportionately more at tension points.

It is believed improbable that a line sufficiently well insulated to withstand low-frequency high-power disturbances is likely to encounter trouble from high-frequency disturbances.

From the standpoint of deterioration, the noncemented types of disk insulator, which avoid the effects of dissimilar expansion of the component materials, seem to offer and to be demonstrating marked advantages. For service at dead-end points the unsuitability of the standard disk is so pronounced that it is considered probable that resort will have to be made at once to an entirely different type of insulator. Considerable promise is offered by a relatively new type of insulator —a wooden rod insulated with compound and inclosed in a suitably petticoated procelain shell. Any desired mechanical strength can readily be obtained in an insulator of this type, so that the full dead-end tension would be carried on one unit.

Reliable and satisfactory clamps are now on the market for composite cables of somewhat smaller sizes as it is not expected that any significant difficulty will be encountered in the design of clamps suitable for a cable of the size proposed. In the design of all cable clamps for use at 220 kv., however, especial care would be required in the avoiding of sharp projections, ridges or points which might afford opportunity for formation of corona or static discharges.

Equalizer yokes and connectors present more of a problem than for present lines, since, as noted earlier, even at suspension points two or three insulator strings in parallel would be used, while if disk insulators were to be used at tension points, not less than six parallel strings would be necessary.

The long economic life which presumably a 220-kv. line would represent causes durability of material to assume even greater importance than in present practice, so that for most localities wood construction would not be economical, even assuming that the requisite strength for the heavy loads could be secured without resorting to unduly short spans. Therefore the conventional rigid steel tower has been adopted as the most available for construction in the immediate future, and a series of standard towers of different strengths, adapted to safe and economical use under varying conditions of span lengths and angles, are considered according to the growing practice in heavy line construction. The loading basis assumed for a 220-kv. line makes it feasible, and desirable from the standpoint of economy of steel, to carry this differentiation to a greater extent than has been customary heretofore. The costs, plotted in Fig. 5, show maximum economy with normal spans of 800 ft. (240 m.) with the rigid type of tower, while longer spans or shorter spans are more expensive. The standard tower heights assumed for the four normal span lengths—550, 700, 800 and 1000 ft. (165, 210, 240 and 300 m.)—are 47, 57, 63 and 80 ft. (14.3, 17.3, 19.2 and 24.3 m.). Besides the margin of safety provided by the design loading, a further margin is introduced in the difference between working and test loads—*i.e.*, 25 per cent for suspension towers and 35 per cent for angle and dead-end towers.

While in general the character and arrangement of equipment at generating stations and substations were not a part of the primary scope of Mr. Silver's paper,

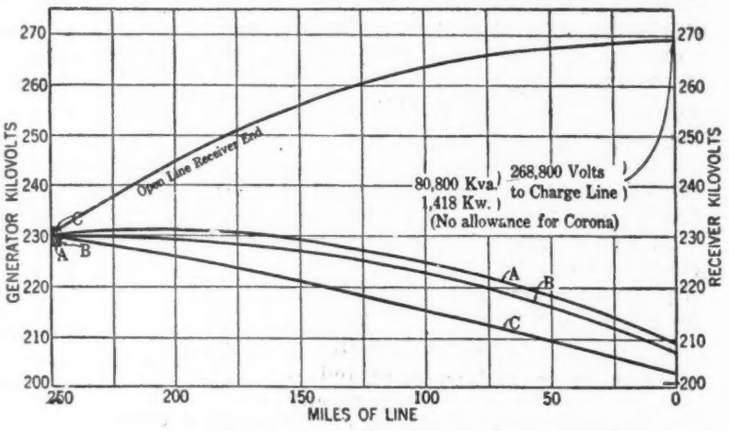


FIG. 4—CHARACTERISTICS OF ALUMINUM-STEEL TRANSMISSION LINE (SEE FIG. 1)

A refers to conditions with zero load and 49,800-kva. leading condenser capacity; *B*, 50,000-kw. load with 7500-kva. lagging condenser capacity; *C*, 100,000-kw. load with 81,000-kva. lagging condenser capacity. Loads delivered at 0.75 power factor.

there are certain features in connection with this equipment which directly concern the feasibility and the economic and general advantages of transmitting power at this high voltage. For instance, design for such large capacities and high voltage centers around one cardinal principle, simplicity and intrinsic strength of equipment, rather than flexibility and external protective measures. The number of buses should be reduced even to a rudimentary form, superfluous oil switches should be eliminated, and spare or reserve units need not be provided. Of course the complete omission of reserve equipment is predicated on adequate reserve capacity being available in local generating stations and on the high standard of construction formerly emphasized.

FACTORS THAT AFFECT FEASIBILITY AND ECONOMY

Certain features of the problem are high reactance of generators and transformers, ample insulation of transformers and an efficient oil circulation system, high mechanical strength of oil switches, avoidance of low-voltage buses and low-voltage paralleling, and an effective and dependable system of relay sectionalizing. All line switching, automatic or manual, should be done on the high-voltage side of transformers. The amounts of power involved, particularly under abnormal conditions, are so tremendous that the current values obtaining at lower voltages impose switch duties and heavy stresses generally which could be handled only with great difficulty and at an expense materially higher than would be required at 220 kv., when the currents involved are relatively small. No equipment of any character is contemplated for protection against over-voltages.

Considerations of simplicity in station arrangement and of economy in operation favor, in general, transformers of the largest size permitted by the conditions of each installation or by limitation of manufacture. At the present stage of the art the manufacturers advocate that transformers be not attempted beyond 50,000 kva. to 60,000 kva. for three-phase units, or beyond 35,000 kva. to 40,000 kva. for single-phase units. As to choice between three-phase and single-phase units, from the standpoint of simplicity and cheapness of installation, three-phase units would be preferable. At generating stations operating and economic considerations strongly favor the generator and its transformer equipment being connected and operated as a unit.

The large sizes of installations involved in a 220-kv. system, together with the necessity for careful attention to maintaining insulation strength and transformer reliability generally, will not improbably result in the abandonment of cooling the oil in each transformer and gravity circulation of oil through the windings in favor of forced oil circulation and external cooling. Short-circuit current values at 220 kv. are not extreme, and in a 220-kv. circuit breaker the large clearances and switch openings necessarily required by the high voltage contribute directly to giving the rupturing capacity required by the current to be handled. Two types of circuit breakers have been offered by the manufacturers for 220-kv. high-duty service. One type consists of a massive circuit breaker, each phase in one tank of heavy boiler plate, with two breaks in series for moderate duty and four breaks in series for heavy duty. Another type consists of two breaks in series per tank, one such tank being used for conditions of moderate duty and two tanks in series for heavy duty.

Substation layout rated at 220 kv. will be influenced largely by the particular local conditions of each installation. The usual type will probably serve to step down from 220 kv. to a secondary transmission voltage, such as 66 kv. or 110 kv. In such a case it will, in general, be necessary to have both a primary and a secondary bus system—at 220 kv. a simple bus with sectionalizing circuit breakers; at secondary voltage, where greater flexibility would seem desirable, probably a ring bus. Owing to the high current values which would obtain at the secondary voltage (it should be kept in mind that the large condenser capacity will aggravate short-circuit conditions), it appears advisable to provide sectionalizing reactors in this bus.

The station and substation arrangements which have been proposed are predicated upon a relay system which

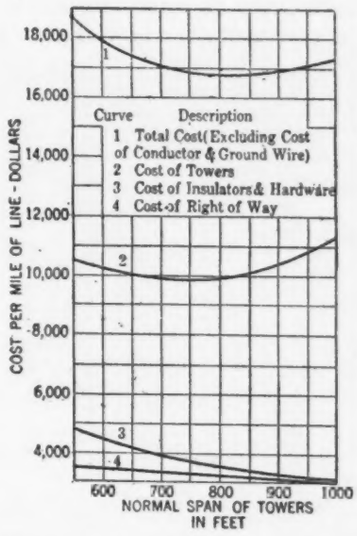


FIG. 5—RELATION OF SPAN LENGTH TO FIRST COST FOR 220-KV. TRANSMISSION

may be depended upon for insuring that a faulty piece of apparatus, transmission line or low-voltage feeder will be cut out correctly, promptly and in such a manner as to avoid interruption to the other elements of the system.

The following estimates are intended to give an indication of the installation cost of construction carried out along the lines of the assumptions and recommendations in this paper:

STEP-UP SUBSTATION

Outdoor transforming and switching structures and equipment (220-kv. apparatus and connections only), installations and indirect expense ..... $8 to $9 per kw.

STEP-DOWN SUBSTATION

Outdoor transforming and switching structures and equipment (does not include low-tension feeder bus or feeder switching equipment), synchronous condensers of capacity for length of connected lines, building, control equipment, installation and indirect expense..... $15 to $20 per kw.

TRANSMISSION LINES

Single-circuit, steel towers, suspension insulators.

	Per Mile
Towers	$8,000
Insulators and hardware	2,800
Conductors and ground wire	5,000
Special structures	1,000
Right-of-way	3,000
Indirect expense	3,700
Total	$23,500

TOTAL COST 220-KV. TRANSMISSION

	Per Kw.
100 miles	$40 to $45
200 miles	$60 to $65
300 miles	$80 to $85

Illinois Coal Mine Electrified Throughout

Coal Company Estimates 50 per Cent Saving by Using Central-Station Service—Energy Distributed at 2200 Volts Inside the Mine—Both Alternating-Current and Direct-Current Equipment Employed

THE proposition of erecting and operating a steam power plant was accurately balanced against using central-station service by the Valier Coal Company, a subsidary of the Chicago, Burlington & Quincy Railroad Company, after it had concluded in 1917 to mine the coal beneath its property at Valier, Ill. The decision was in favor of purchased power, it being estimated that central-station service would be cheaper

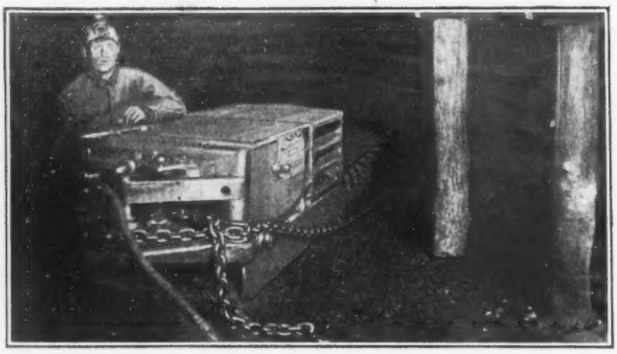


FIG. 1—ELECTRIC SERVICE FOR OPERATING THIS SULLIVAN COAL CUTTER IS SUPPLIED THROUGH CABLE IN FOREGROUND

by $30,000 or $40,000 per annum than equivalent service furnished by a steam power plant erected on the ground. This condition existed partly because the power company offered to supply service from three interconnected generating stations, the service from which could not have been duplicated without providing considerable reserve equipment in the isolated plant, which would have entailed an additional expenditure of about $200,000. Furthermore it would have increased the operating expenses for power by about 50 per cent. It was estimated that the total cost for electric power, including that used for hoisting, ventilating, hauling, undercutting and pumping, would be approximately 3 cents per ton of coal, whereas some of the best isolated steam plants operating under similar conditions were showing a power cost of about 5 cents a ton. These figures are all based on the mine's full output of 6000 tons of coal per day. When the mine runs only part time, the comparison would be even more favorable to purchased power because of the high fixed charges which are inherent in isolated-plant operation.

ELECTRIC SUPPLY AND DISTRIBUTION

Primary three-phase, 60-cycle service is purchased from the Central Illinois Public Service Company at 33,000 volts. Three 666-kva., single-phase transformers reduce the pressure to the general distribution potential of 2200 volts, although two of the transformers are expected to carry the entire load on open delta if for any reason one transformer has to be cut out of service. The high distribution potential of 2200 volts was desired because the underground workings of the mine will ultimately cover about 7500 acres (3000 hectares) and coal will be mined beyond a radius of 2 miles (3.2 km.) from the bottom of the mine shaft. It was also desired to keep the energy losses and copper investment as low as practicable without jeopardizing the safety of the mine. Before deciding on the 2200-volt distribution, however, the plans for the entire installation were laid before the Illinois State Mine Inspection Department and its approval was obtained. Two-hundred-and-twenty-volt service was adopted for lighting the mine and 110 volts for lighting in the miners' homes to discourage men stealing the company's lamps.

Stationary electric lamps are used only underground at the shaft bottom, charging stations, junction points, coal-cutting machines, etc. For locomotive headlights bare tungsten lamps of 60 watts or less are used. Carbon and mill-type tungsten lamps are being tried for this service as regular tungsten lamps will not stand the vibration.

The electric energy required for light and power underground is carried into the mine by a circuit of three single-conductor 300,000-circ. mil flexible "Okonite" lead-covered cables insulated for 5000 volts. A three-core cable was considered, but its greater liability to breakdown lead to the choice of the three single conductors, because this circuit is run down the air intake shaft, in which there is no hoist or other means of getting at the cables in case of trouble. Inside the air shaft, which is 660 ft. (200 m.) deep, the cables are spaced 12 in. (30.5 cm.) apart and held by split-pine

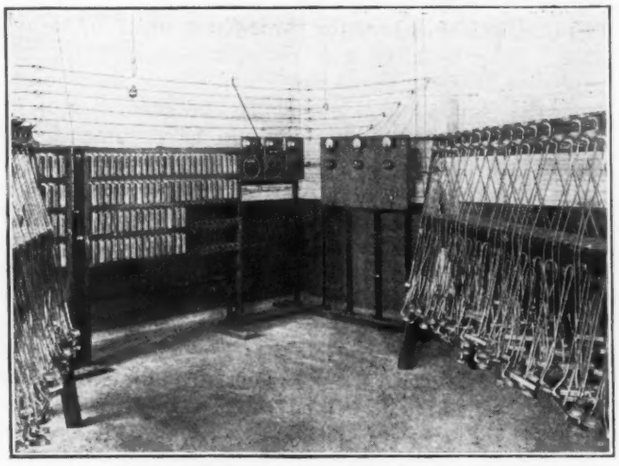


FIG. 2—CHARGING STATION FOR SAFETY LAMP BATTERIES

Control panels and charging racks for 100 batteries shown in center of picture. Flexible connections with lamp on one end and cover for battery case on the other are hanging on side racks. Covers are locked on to battery cases before outfits are given to miners.

clamps, spaced 18 ft. (5.5 m.) apart. As shown in Fig. 5, three notches are cut in each half to clamp the cables in position.

The main underground entries are in the form of the letter H, the air shaft intersecting it at the center of one of the sides. Switches are installed at this point to control the distributing feeders, each of which consists of No. 0 three-conductor armored cable insulated for

5000 volts. Each cable is buried in a trench about 1 ft. (30.5 cm.) deep and covered with 1.5-in. (38-mm.) planks to protect the cable from picks and shovels. Earth is filled in over the planks.

The 2200-volt feeders are kept in the main entries through which the mine gets its supply of air. When it is required to set up a motor-generator or a bank of transformers to reduce the distribution voltage, the necessary space is excavated at one side of the entry and the equipment is installed on the floor. Care is taken to provide adequate ventilation, and fences are erected to keep unauthorized persons out of the room. Automatic oil switches are used exclusively to control and protect the 2200-volt feeders. On the secondary side of the transformers regular inclosed fuses are used.

The batteries are charged in sets of a hundred in a rack, which also serves for storage purposes. In the rack above each cell position are spring contacts which connect the cells in series with a 5-kw. motor-generator. To obtain the correct voltage, an adjustable resistance is used. Larger motor-generator sets are employed to supply direct-current service to the main hoist above ground and to the locomotives down in the mine.

Two types and sizes of 250-volt direct-current General Electric trolley-type mine locomotives are being used. One type, a 7½-ton (6800-kg.) locomotive, gathers the coal as it is mined and brings it to one point in each district. The other type, rated at 15 tons (17,600 kg.), hauls the coal to the main shaft, where it is hoisted out of the mine. The 15-ton locomotives are

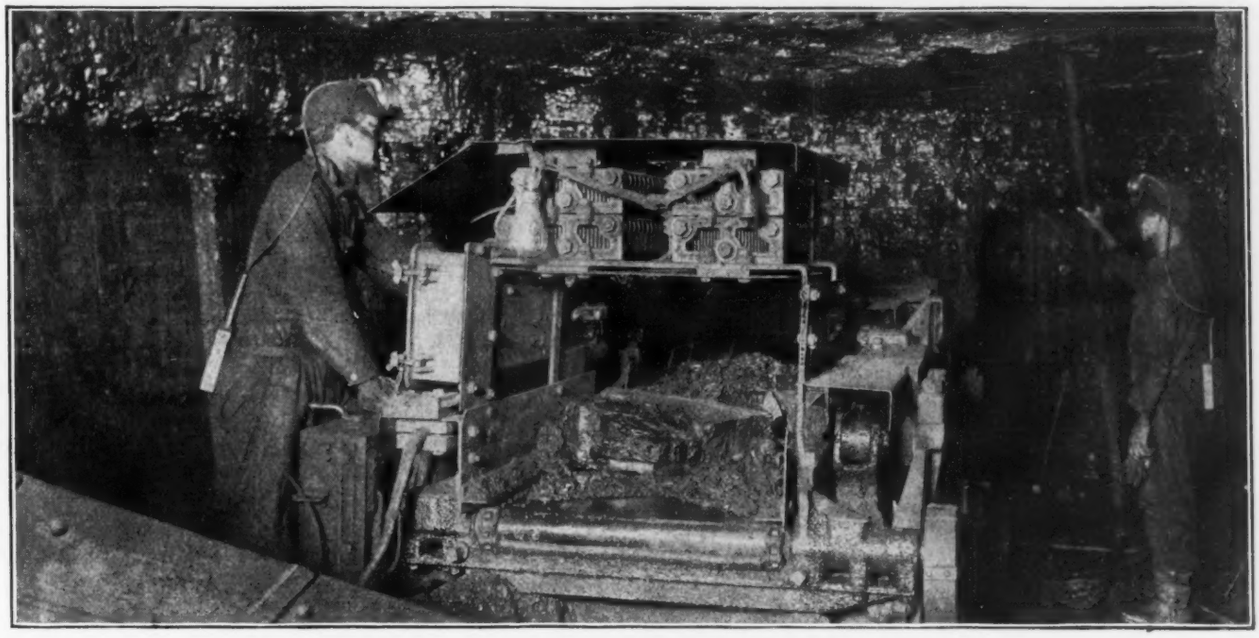


FIG. 3—DIRECT-CURRENT ENTRY DRIVING MACHINE IN OPERATION

This machine is taking the center out of the coal seam and leaving sufficient coal to serve as substantial walls and ceiling of entries without use of timbers. Note smooth wall on left-hand side. Coal is discharged through the square opening shown at the back of the machine and is dumped into cars by the conveyor in the foreground. Note electric safety lamps on operators. The main transformers on the right are each rated at 666 kva., 33,000/2300 volts, single-phase, 60 cycles, and the small transformers on the platform are used to supply lights and small motors above ground.

Open carbon circuit-breakers protect the direct-current end of the motor-generators from overloads and from short circuit on the trolley system.

When the mine was first put in operation the miners objected vociferously against the use of electric safety lamps. They claimed that the old carbide-flame lamps were much better and weighed only half as much as the electric lamp and battery. However, this was a new mine, and the management insisted that it be started correctly with electric safety lamps. Furthermore, the Bureau of Mines recommends electric miners' lamps because they decrease the hazards. Besides, the lamps provide more light in a more convenient form than the old safety lamps. The electric safety lamp used is known as the "Edison approval No. 10" and consists of a lamp inclosed in a steel reflector which is usually carried on the front of a man's cap. A two-cell Edison battery inclosed in a locked steel box is strapped around his waist. The entire equipment weighs 4 lb. (1.8 kg.) and can be carried without inconvenience. Having a capacity of 44 lumen hours, the battery will maintain the lamp at a brilliancy of 1.21 cp. for twelve hours.

equipped with two 90-hp., 250-volt direct-current series motors which are only operated from a trolley wire. The 7½-ton locomotives are equipped with two 28.6-hp. motors and an auxiliary battery. By means of the latter it is possible to get coal out of the parts of the mine where the quantities of gas make it dangerous to use a trolley.

In selecting the battery it was necessary to choose one which would need the minimum of expert care and attention, be reliable, have low maintenance expense and a high salvage value after at least four or five years of service. According to the company's engineer, the Edison battery came the nearest of all to meeting these requirements, and although the coal company paid about 25 per cent more for the Edison batteries than it would have had to pay for some other type, it feels that in the long run this battery will be cheapest.

One hundred and ten Edison A-60 cells were installed on each of the locomotives. Although the normal potential of the battery when operating a locomotive is 110 volts, it can be connected directly across the 250 volts and charged without injury. Normally, however, it is charged at 180 volts because it is not thought

desirable from the standpoint of efficiency to have the 110-volt batteries floating on the 250-volt trolley. A throw-over switch permits connecting the motor to the trolley or to the battery, depending on the source from which the locomotive is to be operated. While the locomotive batteries could be removed for charging and replaced by others fully charged, the present practice is to charge the battery in the locomotive at night when it is not in use. To do this the locomotive is sidetracked near one of the motor-generator sets and the direct-current voltage reduced from 250 volts to 180. Each battery is rated at 24.75 kw.-hr. and the five-hour discharge rate is 45 amp. Energy is supplied to the trolley wire by 100-kw. and 150-kw., 250-volt direct-current generators driven by direct-connected, 2200-volt, three-phase, 60-cycle motors installed underground at the points of heaviest hauling.

Above ground is a 1000-kw. separately excited flywheel motor-generator set with Ilgner control for operating the main skip-hoist motor. This motor is rated at 1350 hp., 55 r.p.m., 550 volts, direct current, and is direct-connected to the 9-ft. (2.74-m.) drum of the hoist. Direct current was selected to operate this hoist because of the greater flexibility of control and because the motor-generator set was desired to reduce the surges on the power company's system. A skip hoist was chosen in preference to a self-dumping cage because in the

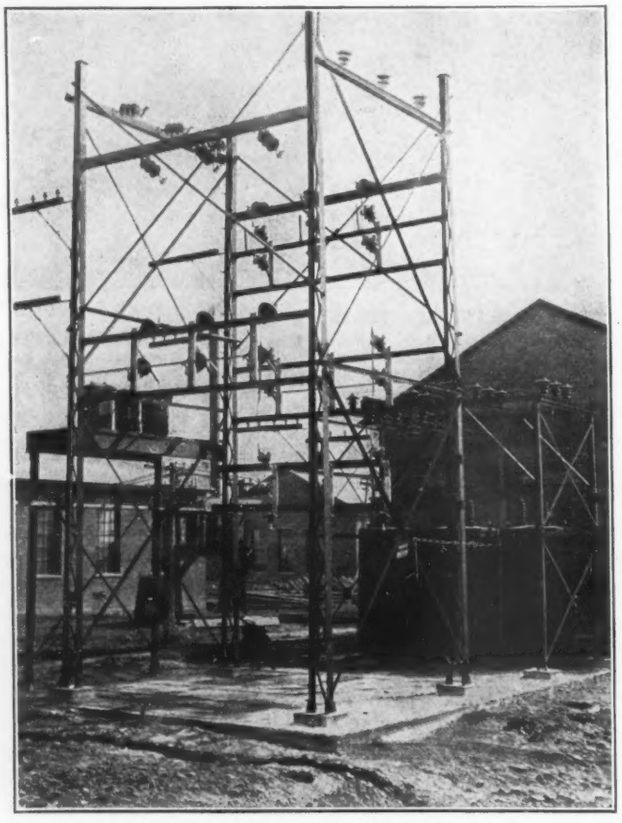


FIG. 4—OUTDOOR SUBSTATION SERVING VALIER (ILL.) COAL MINE

skip hoist the coal is about one-half the gross weight hoisted, whereas with a self-dumping cage under similar conditions only about one-third of the gross weight would be coal. A gross weight of about 25 tons (22,700 kg.) can be lifted by the hoist at a rate of 1550 ft. (472 m.) per minute, giving a capacity of 1000 tons (910,000 kg.) of coal per hour. Push-buttons at the bottom of the shaft are employed for starting the hoists. Once started it is automatically brought up to speed, retarded and stopped automatically at the top where the coal is dumped out. In case of emergency the operator can stop the hoist by pressing another button.

A mine of this character requires much direct-current equipment, but three-phase motors, connected through

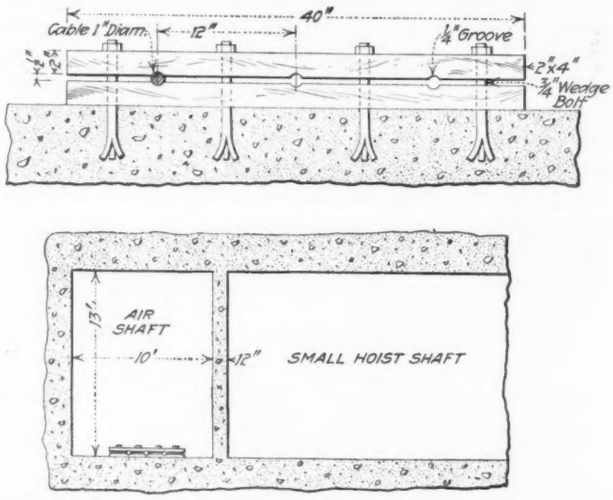


FIG. 5—DETAIL OF PINE CABLE CLAMPS AND SECTION OF AIR SHAFT, SHOWING LOCATION OF THREE 300,000-CINC-MIL. CABLES FEEDING UNDERGROUND WORKINGS

transformers to the power company's lines, are used wherever practicable.

Twenty C.E7 Sullivan coal cutters are being used to undercut the coal. Each of these machines is equipped with a 35-hp., 220-volt, three-phase, 60-cycle motor, and twenty more similar machines are on order. Two Jeffrey B34 entry-driving machines are being used for development work. These drivers are equipped with direct-current motors because they were the only machines of this type which the company could get at the time and the direct-current motors could not readily be replaced by alternating-current units. As the coal cutters advance into the seam some mines have pumping equipment to keep the mine free from water, but at this mine the pumping load is negligible.

In addition to the equipment mentioned about 200 hp. in motors is required for the tipple machinery, 25 hp. is used in the machine shop, a small motor operates the electric siren, and a 225-hp., 2200-volt motor drives the ventilating fan. All these motors are wound for three-phase, 60-cycle service. Since the main ventilating fan is the most important piece of equipment at the mine and must be kept operating at all costs, provision is made for driving the fan in emergencies by steam from a boiler ordinarily used for heating the buildings and supplying water. Clutches have been installed by which the fan drive can be quickly changed from motor to engine drive.

The entire alternating-current load connected to the central-station line will be the equivalent of about 3000 hp. when all the equipment has been installed, and when the mine reaches its full rated output of coal the maximum demand is expected to be in the neighborhood of 1300 kw. Carl Scholz, general manager of the Valier Coal Company, planned the entire layout of the mine, superintended the installation of the equipment and more than any one else is responsible for the success of this whole undertaking.

Protecting Tie Lines with Relays

Extensive Data Have Been Collected Giving the Experience of Operating Companies with Various Methods of Relay Protection—Tests Should Be Made Under Conditions Approaching Actual Ones

IN MANY of the older electrical systems stations and lines have been added as required without taking into consideration the relay problem. Many newer systems also have been laid out without adequate provision for relay protective systems. But lines can no longer be adequately protected merely by overload and time setting of the relays, for the growth and complication of networks makes necessary the sectionalizing of trouble. In a paper entitled "Present-Day Practice of Transmission and Tie-Line Relay Protection," by H. R. Woodrow, D. W. Roper, O. C. Travers and P. MacGahan, presented at the annual convention of the American Institute of Electrical Engineers this week, this problem was taken up in the light of answers to a questionnaire sent out by the committee on protective devices in which a study of the practice of thirty-two operating companies in relay protection has been made available.

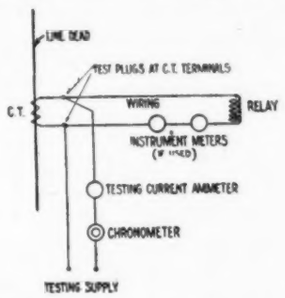


FIG. 1—TESTING CURRENT IN SECONDARY OF CURRENT TRANSFORMER

The report covers the experience of companies with systems varying from 25,000 kva. to 455,000 kva. whose short-circuit currents at any point vary in value from 100,000 kva. to 1,650,000 kva. and sustained short-circuit kva. values vary from 20,000 kva. to 340,000 kva. Practically all the companies report some trouble with the operation of their protective relay systems. Of these troubles 46 per cent are reported as due to the difficulties in the relays, 20 per cent to improper application of the relays and 15 per cent to improper settings of the relays, 9 per cent to defective wiring, and 10 per cent to defective operation of the oil breakers. The economy of parallel feeders in established and approved methods of testing and setting of the relays are discussed in this paper.

Advantages of Parallel Feeders

While the saving which can be effected by a parallel operation of feeders depends in a large degree upon the design of the transmission system, in one system supplying converters ranging in size from 500 kw., it was estimated that if the feeders could be operated in parallel a saving of 20 per cent would be made in the investment. As the installation in question had a book value of about $5,000,000, there was a possible saving estimated at $1,000,000. During two years of operation with feeders in multiple they have realized nearly 40 per cent of the possible saving in the investment in feeders notwithstanding a considerable increase in the maximum load. Cable burn-outs, due to operation of the feeders in multiple, have also been reported by this company. While the time is rather short to accept these figures as conclusive, it apparently indicates that the operation of feeders in parallel reduces the number of troubles due to internal causes. Of the companies reporting, 60 per cent operate with the major part of their lines in parallel and 40 per cent operate with some of their lines in parallel groups.

The most perfect relay system cannot be expected to give the best results unless the man in charge of its installation and operation be thoroughly competent and familiar with the various precautions to be taken. One of the principal factors controlling the setting of relays is the amount of short-circuit current available under various conditions. While the determination of short-circuit currents is a difficult problem in the case of networks, various formulas and calculating tables have been developed for simplifying this work which give sufficient accuracy for practical purposes.

Testing and Setting Relays

To secure the best results from relays it is desirable to make a complete check on the current and time settings of each relay on the first installation and at least once every six months thereafter. The tests should be performed under conditions as nearly equal to operating conditions as possible, including the wiring and complete relay equipment in this test. Where it is impracticable to apply test current to the primary of the current transformer, this testing current may be supplied to the secondary terminals of the current transformer with the transformer left in circuit as a shunt as shown in Fig. 1. The results obtained under these conditions very closely approximate those under short

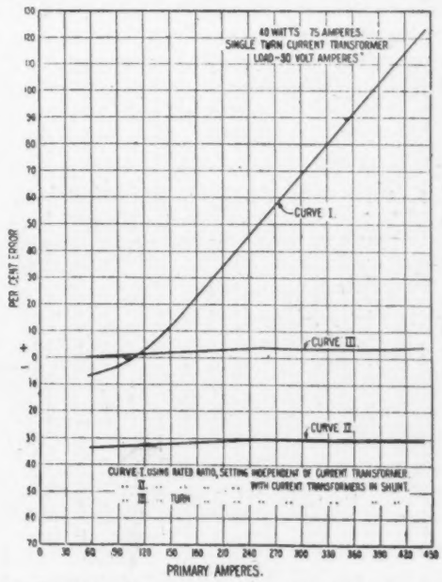


FIG. 2—COMPARISON BETWEEN TESTING CIRCUITS

circuit and check the relay wiring and current transformer as well as the relay. The degree of accuracy obtained when the relay is tested alone is dependent upon the type of transformer used in secondary load. The error in this method is due to the high magnetizing current of transformers under heavy short-circuit conditions. As an example, a 40-volt-ampere secondary load on a current transformer at full load imposes a 16-kva. load under short-circuit conditions of twenty times full load. This in many mases is above the saturation point of the transformer and the ratio breaks down badly. The accompanying curves in Fig. 2 illustrate these conditions.

It is desirable to have the relays so set that selective action will be obtained under all probable conditions. Where a large number of circuit breakers are in series and selectivity is desired between the several breakers, it is possible to apply at the various points relays having different characteristics in order to reduce the time that a short circuit is held on the system near the generating station. The time characteristic curves in Fig. 3 illustrate a specific case where this method was adopted. It may be observed from the curves that the maximum short-circuit current that can pass through relays *A*, *B*, *C* and *D* is 2800 amp. and that the relays at this point are set selectively with approximately three-quarters of a second between them successively. Greater currents may pass through circuits *A* and *B* with the short circuit on these feeders near the generating station, and the time characteristic curve being much steeper at this point will allow the relays to open the circuit very quickly.

Some companies have made the time of their relay operation longer in order to permit the system voltage to drop in value, thereby reducing the rupturing strains on the oil switches. It is pointed out, however, that considerable precaution should be taken when this is done as the prolonged current may do more damage than the greater rupturing arc in the switch.

METHOD OF TRIPPING

The use of circuit-opening relays for alternating-current tripping has not given very satisfactory results. It is desirable to have a definite uninterrupted supply

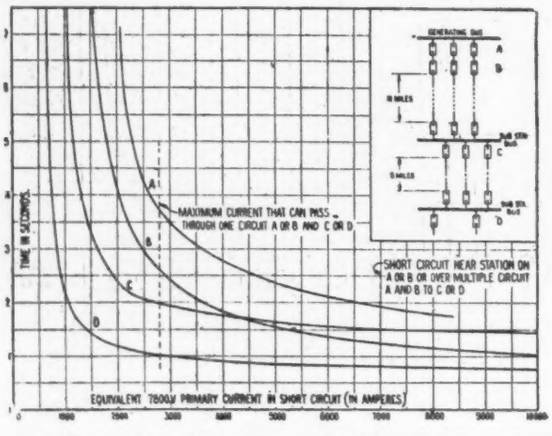

TIME IN SECONDS
MAXIMUM CURRENT THAT CAN PASS THROUGH ONE CIRCUIT A OR B AND C OR D
SHORT CIRCUIT NEAR STATION ON A OR B OR OVER MULTIPLE CIRCUIT A AND B TO C OR D
EQUIVALENT 7800V PRIMARY CURRENT IN SHORT CIRCUIT (IN AMPERES)

FIG. 3—TIMING RELAYS ON PARALLEL FEEDER SYSTEMS

of power for tripping, and the storage battery has proved to be reliable even in very severe system disturbances. In answer to the questionnaire it apears that 80 per cent of the companies used direct-current tripping and found it satisfactory and preferable. For accurate timing 63 per cent of the companies have adopted some form of automatic chronometer or cyclo-counter. Fifty per cent of these companies are testing under conditions approximating short circuits. It is also shown that the average time for which a short circuit is kept on the system is three and one-third seconds, although this time varies with different companies from one-quarter of a second to as high as fifteen seconds.

PROTECTIVE RELAY SCHEMES IN USE

It was found that, of the companies reporting, 13 per cent prefer the combination of time current and directional relay schemes, 13 per cent the balanced pair,

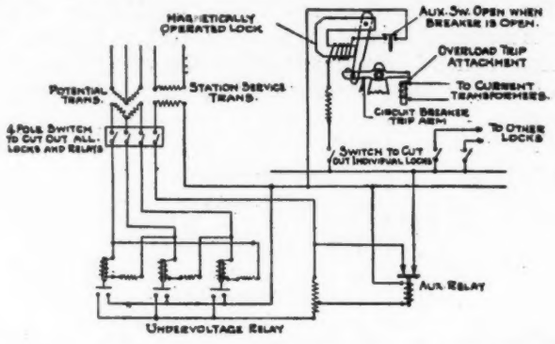

MAGNETICALLY OPERATED LOCK
AUX. SW. OPEN WHEN BREAKER IS OPEN.
OVERLOAD TRIP ATTACHMENT
POTENTIAL TRANS.
STATION SERVICE TRANS.
TO CURRENT TRANSFORMERS.
CIRCUIT BREAKER TRIP ARM
4 POLE SWITCH TO CUT OUT ALL LOCKS AND RELAYS
TO OTHER LOCKS
SWITCH TO CUT OUT INDIVIDUAL LOCKS
AUX. RELAY
UNDERVOLTAGE RELAY

FIG. 4—CONNECTIONS FOR UNDER-VOLTAGE AND OVER-CURRENT RELAY SCHEME

6 per cent the split conductor, 6 per cent straight inverse time current protection, and 3 per cent balanced relay with pilot wires.

The directional relays produced at the present time are apparently giving very satisfactory results, even under low-voltage conditions down to 1 per cent of normal, and may be applied to loop or parallel group systems in series, in combination with inverse-time current relays, if a careful analysis is made of the proposed installation. In order to secure the operation of the directional relays under bad power-factor conditions, the connections are made so that the maximum torque is obtained with lagging power factor. This may be accomplished by several schemes of connections of the potential and current elements. Some operators have found it advantageous, when using directional relays with step-down transformers or reactors, to connect the voltage elements of the relays to the bus side of this apparatus in order to give a higher voltage in case of short circuit.

Many operating companies have installed on a portion of their lines protective equipment which is designed to be inoperative so long as the currents in different circuits at different points in the same circuit are substantially equal. To this end they have made use of (a) fully insulated lines in parallel between stations, (b) conductors in parallel having reduced separating insulation—*i. e.*, split conductor cable—and (c) pilot wires of relatively small cross-section between the two ends of a line to sense the degree of balance of the currents at these points. A series of diagrams were presented by the authors showing the wiring of relays for balanced protection of two parallel lines and indicating by arrows the operation of the relays under each condition. In the event of one line being in service alone, it is the general practice automatically, by means of auxiliary switches on the circuit breakers, to introduce time over-current relays in the protective equip-

ment which will operate in conjunction with the directional relays in a manner similar to that of the tandem groups or loop circuits. Several companies reported that they had had difficulty in finding proper relay protection in cases where they have taps on the tie line between stations. This is particularly true where the protection of these lines would have been of the balanced-relay type were it not for the taps.

Split-conductor cables are being tried out in this country by two operating companies who report good results to date. The cable is composed of six conductors, each of the three phases being "split" into two halves. For specific information regarding this system the reader is referred to a paper by W. H. Cole, "Split Conductor Cables—Balanced Protection," *Proceedings A. I. E. E.*, July, 1918, page 793. Adaptations of the Merz-Price protective system have been used by two operating companies. One of these reports very satisfactory results; the other is not so favorable, due to an inherent difficulty in obtaining the proper degree of balance.

One company employs a combination of under-voltage and over-current relays for its system which has given it very good results. In this scheme all the circuit breakers in any section are mechanically locked in the closed position by means of a magnetically operated lock. It is controlled by a voltage relay which releases the lock when the voltage falls below a predetermined value, approximately 70 per cent. Upon the occurrence of a short circuit the voltage drops, and when it has fallen below the predetermined point the voltage relays act to unlock the circuit breakers, which are then free to be opened by the over-current relay or other over-current device. Referring to diagram, Fig. 4, the under-voltage relays are connected to the secondaries of potential transformers on the line busses. An auxiliary relay is actuated from the station service transformer and is controlled by the under-voltage relays. In its turn this auxiliary relay controls the locks on the circuit breakers. One set of under-voltage relays, with the auxiliary relay, may control a number of locks on a number of circuit breakers. The operation is as follows: When the line potential drops below a predetermined value, one or more of the under-voltage relays drop and short-circuit the auxiliary relay through a resistance which causes this auxiliary relay to open. This in turn releases the latch and leaves all the circuit breakers under its control free to operate in case of over-current. Thus, so long as the potential remains above the predetermined value, no breaker can be opened by its automatic over-current feature.

This scheme is reported as giving successful results on an overhead system covering 4000 sq. miles (100,000 hectares) where there are a large number of stations located, on an average, approximately 10 miles (16 km.) apart. As the lowest voltage occurs nearest the short circuit, it is probable that only the circuit breakers in the immediate vicinity will be unlocked and allow the circuit breakers to be automatically opened if the current is of sufficient magnitude.

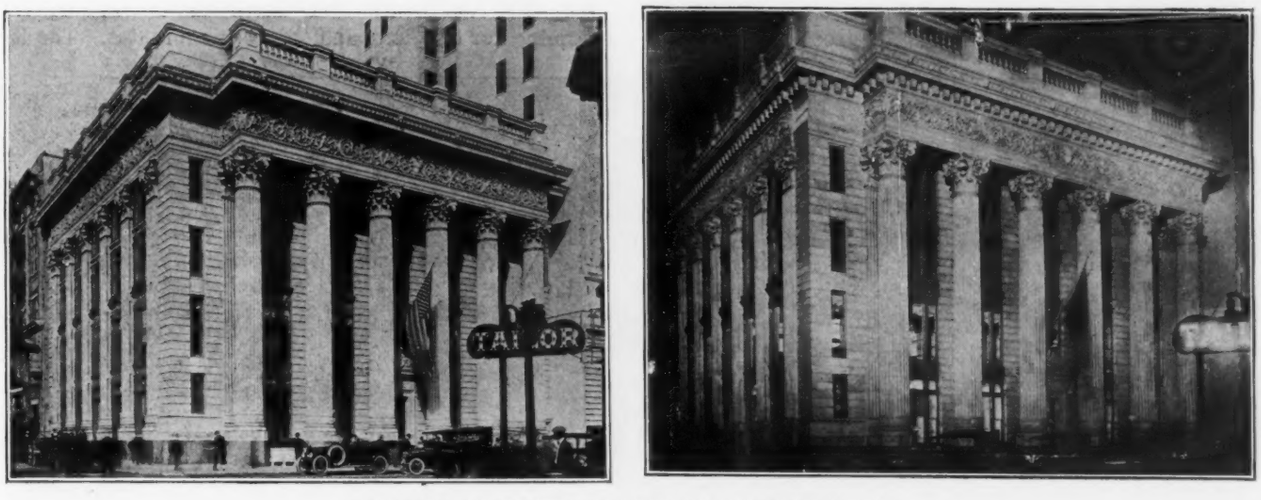
FLOODLIGHTING REQUIRES SPECIAL KIND OF TREATMENT

Must Produce with Artificial Light Same Effect of Light and Shade as That Obtained by Day to Emphasize Architecture

BY F. H. MURPHY

A GENERAL opinion prevails that floodlighting is an elementary matter, that it consists only in finding some place on which to mount the units and then in directing the light all over the object to be illuminated. This idea is erroneous. Such a method may sometimes attain its object, but often it will destroy it. Floodlighting, for the purpose of perpetuating throughout a longer day beautiful pieces of architecture or sculpture, is too technical an affair for such haphazard treatment.

A building worthy of floodlighting is usually attractive because of its architectural features. Destroy the effect of these, and there is nothing left to admire or to warrant the expense of lighting. Architectural effects are dependent upon light and shade. Shadows are the result of directional lighting. The great directional day-lighting unit is a constantly varying quantity. However, for a building whose front faces east or southeast the average effect when seen at its best would be that of mid-forenoon sunlight. It is assumed that the architect, therefore, worked out his details with this idea in mind.



DAYTIME AND NIGHT-TIME VIEWS OF SAME STRUCTURE

If we are to perpetuate the architectural beauty of the building for the enjoyment of the public during the hours following daylight, which is usually the real object of having it illuminated, then every effort should be made to produce with the artificial light the same effect of light and shade as was obtained by daylight. It is probably impossible to make an exact reproduction of even the assumed average daylight effect because of many conditions. For one thing, it is usually impracticable to mount the lighting units at just the proper location. The light source is relatively much larger, hence less of a point source, than the sun, and at night there is a lack of the diffused daylight which tends to brighten the shadows and give a softer and more pleasing effect. If a point source of light, properly mounted, could be obtained at night, the deep contrasting shadows would be disagreeable without the diffused general light to soften them. However, the very limitations in location and size of light source serve to assist in overcoming the lack of general diffused lighting by throwing light from slightly different directions, thereby softening the shadows to a certain extent.

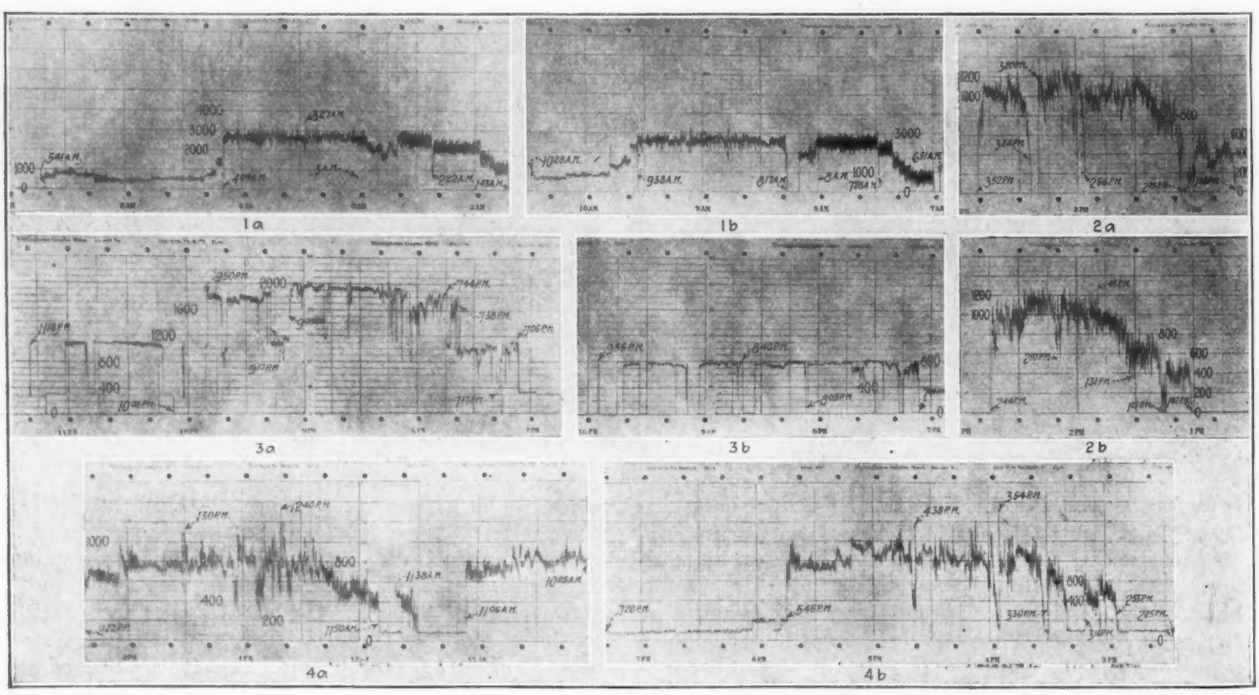
At the time the United States National Bank Building of Portland, Ore., was under construction the matter of properly floodlighting it was taken up with the owners. With their consent and with the hearty coöperation of the architect, A. E. Doyle, a system of floodlighting was designed that would as nearly as possible perpetuate the average daylight effect. The building is 100 ft. by 100 ft. (30 m. by 30 m.), four stories high, and the finish is a light terra cotta. It is on the southeast corner of the block, the front facing east. Diagonally across the street intersection is another building of about the same height. Permission was obtained from the owners of this property to erect an iron framework on the roof for supporting the lighting units. Twelve units were used, mounted upon the iron framework in three horizontal rows of four each, in as compact a formation as possible. There are four 1000-watt units and eight 750-watt units. The intensity of illumination is not high, but the success met in attaining the main object of the installation may be seen by comparing the daylight picture, taken at about 10 a.m., with the night view, taken at about 10 p.m. It is, however, impossible in a reproduction of this nature to do justice to the real night effect

Electric Furnace Operation at Buffalo

Operating Characteristics of Eight Steel Furnaces of Four Different Types, the Heroult, the Pittsburgh, the Snyder and the Greaves-Etchells, Are Described, with Information on Tonnage and Energy Supply

NINE electric steel furnaces are served from the lines of the Buffalo (N. Y.) General Electric Company. Some were installed in 1914 and others just before the war ended, in the latter part of 1918. They include four types, the Heroult, the Pittsburgh, the Snyder and the Greaves-Etchells, the sizes ranging from 2 tons to 10 gross tons.

Charts 1a and 1b, taken at the plant of steel company No. 1, where two Heroult furnaces of 10 gross tons rating are installed, show the kilowatt input for two heats with one furnace only operating. Curve 1a represents an operation in which the furnace was melting for two hours and twenty-seven minutes and refining for one hour and thirty-one minutes. The load



FIGS. 1, 2, 3 AND 4—OPERATION OF A 10-TON (GROSS) HEROULT FURNACE; A 3-TON PITTSBURGH FURNACE LOAD; CHARACTERISTICS OF TWO 2-TON SNYDER FURNACES; OPERATION OF A 2-TON HEROULT FURNACE

factor for the heat was 62.3 per cent, based on a maximum peak of 2700 kw. While a momentary peak of 4000 kw. is registered, the demand during the melting process shows an average value close to 2500 kw. During the refining operation the load ranges from 500 kw. to 1000 kw. Curve 1b represents an operation in which the furnace was melting for two hours and thirty minutes and refining for one hour. The load factor for this heat was 70.3 per cent, based on a maximum peak of 2700 kw. The load characteristics are practically the same as in curve 1a. In both instances the load was entirely interrupted and reëstablished once during the heat.

DATA ON ELECTRIC FURNACE OPERATION AT BUFFALO, N. Y.

Installation Number	Number of Furnaces	Year Installed	Size of Furnace in Tons per Heat	Type of Furnace	Type of Lining	Phase and Frequency	Volts at Arc	Transformer Rating	Transformer Rating for Light and Power	Number of Months Which Data Cover	Monthly Average					Hours per Day Operated	Per Cent Load Factor per Heat
											Maximum Demand	Kilowatt-Hours	Tons Poured	Kilowatt-Hours per Ton	Per Cent Load Factor		
1	2	Oct., 1918	10 gross	Heroult	Basic	3–25	100 to 120	3000 kva. each 11,000/110-volt taps	250 kw.	6	2700	614,500	1050.9	585	33.0	Continuously except for charging and pouring	60 to 70
2	1	Oct., 1918	3	Pittsburgh	Acid	3–25	110 to 120	1000-kva. 11,000/110-volt ½ voltage taps	25. kw.	7	1150	45,143	.....	...	5.4	Varies	70
3	2	1914	2	Snyder	Acid	1–25	160	2250 kva. total* 60 per cent p.f.	270 kw.	12 (1917)	1600	155,817	248.6	627	13.5	Night only (four heats per night)	80
4	1	Dec., 1916	2	Heroult	Acid	3–25	100 to 120	645 kva. 2200/1980/107-volt	105 kw.	16	1023	186,924	196.0	970†	25.5	Six to twelve hours	75
5	2	1918	6	Greaves-Etchells	Acid	3–25	110 to 70	1300 kva. each	300 kw.	6	1650	168,950	.....	...	13.96	.....	65

* These transformers have a connection equivalent to the Scott (or T) connection, so as to give approximately a balanced three-phase load on the primary when both furnaces are operating.

† Includes shop load of 100 kw. to 150 kw. Figure for furnace use only should be between 600 kw.-hr. and 200 kw.-hr.

THE HEROULT INSTALLATION

These furnaces are operating with a basic lining consisting of magnesite brick to the slag line and metalkase brick around the slag line. They were installed for melting and refining and are equipped with General Electric electrode regulators. While the average record in the table shows that over a six-month period they produced steel at an average rate of 585 kw.-hr. per ton, a more detailed record shows that during the first month of operation, when only 459.4 tons of steel were made, the energy consumption was only 555 kw.-hr. per ton.

In March, 1919, when a total of 1316.9 tons of steel were made, the average monthly record of energy consumption was 560 kw.-hr. per ton. The greatest consumption per ton occurred in December, 1918, when the monthly record was 656 kw.-hr. per ton. Some of this variation in kilowatt-hours per ton is due to the fact that the period between meter readings does not cover the exact calendar month, while the tonnage record does. The six-month record is therefore a better indication of actual results.

Curves 2a and 2b, taken at the plant of steel company No. 2, represent the operation of a Pittsburgh 3-ton furnace. It is engaged in melting only, using high-grade scrap. The lining is of silica brick. In the upper curve a melting operation lasting two hours and fourteen minutes is shown. The load factor for the heat was 70.4 per cent, based on a maximum demand of 1125 kw. While this furnace is served from three 333-kva. transformers, the load registered momentary peaks of 1400 kw. In curve 2b a melting operation which lasted one hour and forty-two minutes is shown. The load factor for the heat in this case was 73 per cent, based on a maximum demand of 1125 kw. The furnace is equipped with a Thury regulator. Tonnage records for the six months in which this furnace was operated are not available. In one of the heats shown the load was interrupted and reëstablished once and in the other twice.

In comparing the curves 3a and 3b with the others, it should be remembered that they are taken from two Snyder single-phase 2-ton furnaces (installed in steel plant No. 3). While they were installed in 1914, the data given in the table are a record of their operation during the twelve months of 1917. The furnaces are both provided with an acid lining of silica brick. They are served from 2250 kva. of transformer rating for the two furnaces. The transformers are connected by a scheme equivalent to the T connection, which gives a balanced three-phase load when both furnaces are operating. They operate on a 220-volt circuit in which reactance has been permanently inserted between the transformers and the furnace. The power factor of this load on account of the external reactance is about

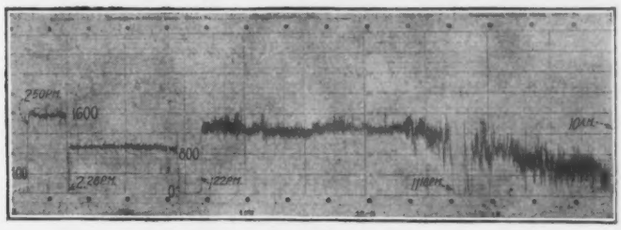


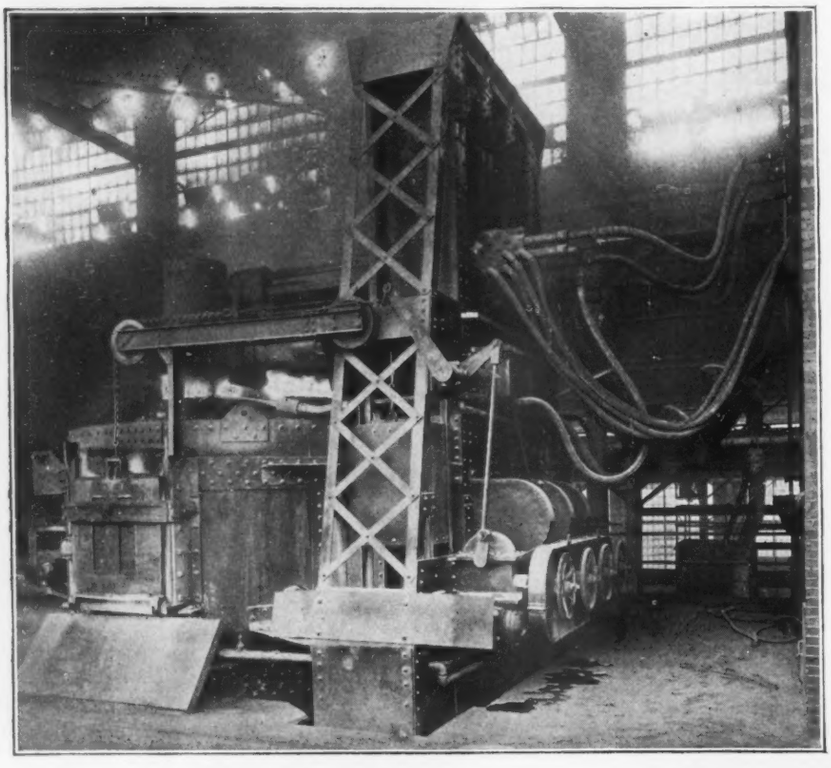
FIG. 5—A 6-TON GREAVES-ETCHELLS FURNACE LOAD

60 per cent. The furnaces are used for melting only, the electrodes being hand-regulated.

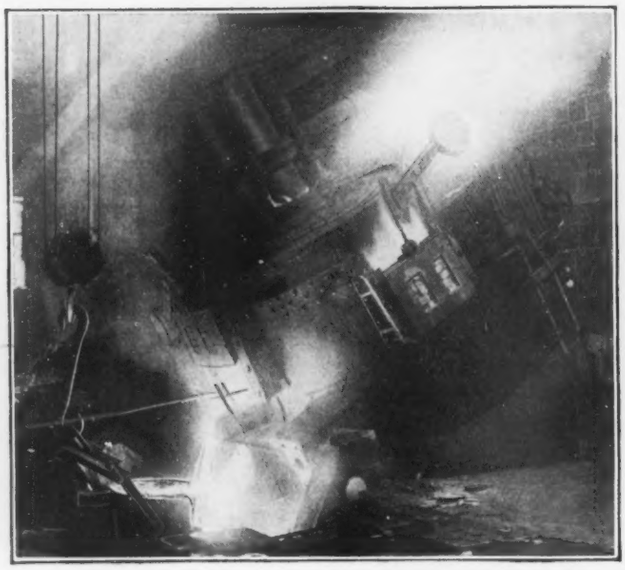
Curve 3a represents the load produced by one furnace operating part of the time and by two furnaces part of the time, with a shop load of 250 kw. to 300 kw. also included. Curve 3b represents the operation of one single-phase furnace melting for two hours and thirty-five minutes. The load factor for this heat was 81.6 per cent based on a maximum peak of 800 kw.

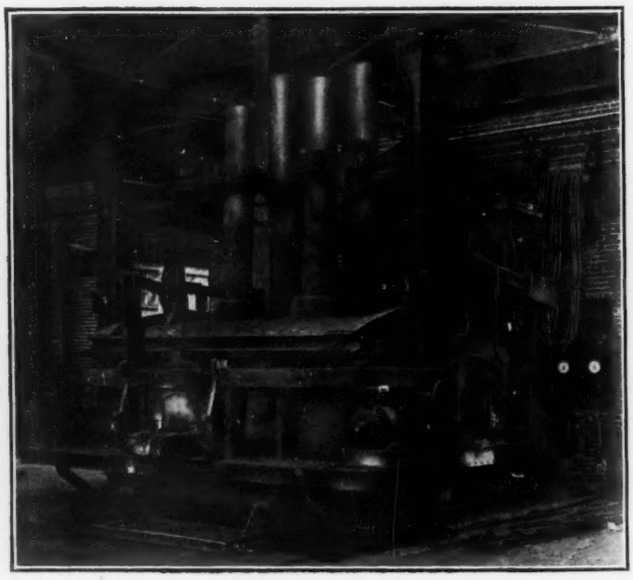
During this heat the load was interrupted and reëstablished six separate times.

An especially complete record is available on a 2-ton Heroult furnace installed at steel plant No. 4. This is a furnace with an acid lining which is used for melting high-grade scrap. It is served by transformers rated at 645 kva., 2200/1980-107 volts. In addtion to this, two 7.5-kva. transformers are installed to supply the furnace auxiliaries and three 30-kva. transformers supply energy for the general shop power. Unfortunately the meters measuring energy on this job are not arranged to separate the shop load from the furnace load, so the data on kilowatt-hours per ton and the curves 4a and 4c include this shop load of from 100 kw. to 150 kw. This accounts for the high average consumption of 970 kw.-hr. per ton. This figure would be between 600 kw.-hr. and 700 kw.-hr. per ton if the kilowatt-hours used by the shop load were taken out of the total. During the sixteen months covered by these data this furnace never ran less than forty-eight heats per month and in one instance poured 112 heats per month. The average for the sixteen-month period was seventy-nine heats per month. The practice was to run from two to four heats per day with approximately three hours per heat.



The curves show the characteristics of the electrical load operating under the control of a General Electric electrode regulator. Curve 4a represents a melting operation lasting two hours and fifty-two minutes. Taking out the estimated energy consumption of the shop, the furnace used 1555 kw.-hr. and had a maximum demand of 750 kw. This would give a load factor of 72.4 per cent. The charge consisted of 5000 lb. of steel scrap, making 622 kw.-hr. per ton. Momentary peaks of 1350 kw. are shown. While the average maximum demand shown in this curve is probably around 900 kw., there were many months when the measured maximum demand ran around 1100 kw. and 1200 kw. in spite of the fact that the transformer rating for the furnace installation is only 645 kva. These demands also include the shop load. The electrode control has been readjusted recently, however, and it is confidently expected that the demand will be less. Curve 4b shows a melting operation lasting two hours and fifty minutes, on which the estimated load factor of the furnace load alone for this heat was 71.5 per cent. This is based on a furnace demand of 850 kw. and a





FIGS. 6, 7 AND 8—TEN-TON HEROULT FURNACE SERVED BY 3000-KVA. TRANSFORMER; POURING A 2-TON HEROULT FURNACE; 6-TON GREAVES-ETCHELL FURNACE

consumption of 1722 kw.-hr. During this heat the furnace used 690 kw.-hr. per ton. Its electrical characteristics are much like those of the upper curve. There are from two to three interruptions of the load on each heat.

The furnaces at steel company No. 5 are Greaves-Etchells 6-ton units and have been used for melting only. Later they will be used for refining, when a

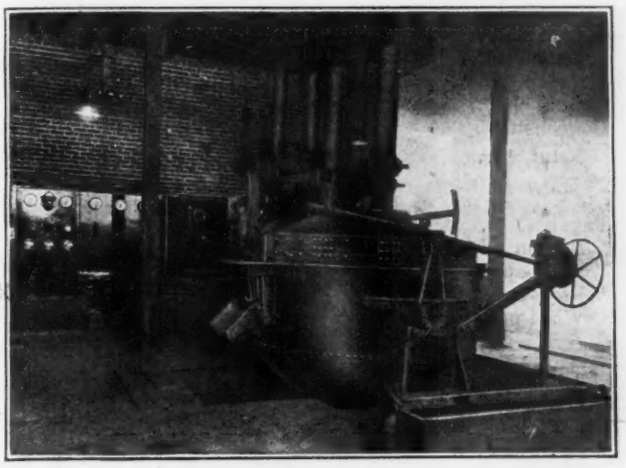


FIG. 9—THREE-TON PITTSBURGH FURNACE FED BY THREE 333-KVA. TRANSFORMERS

basic lining will be installed. Thury regulators are used for electrode control. These furnaces now have an acid lining consisting of ganister and silica brick. Each furnace is served from a 1300-kva. transformer bank, and in addition 300 kva. of transformers is installed for light and power service. In the six months these furnaces have operated the average maximum demand was 1650 kw., and during two months the maximum demand was 1800 kw. Fig. 5 shows load characteristics of one of these furnaces during a melting period lasting four hours and fifty minutes. The load factor was 64.2 per cent for the heat. The highest momentary peak shown on this curve is about 1750 kw. The voltage at the arc on these furnaces, ranging from 110 volts to 70 volts, is somewhat lower than on some other three-phase furnaces. Their load power factor averages 90 per cent or better, with one exception, that being the Snyder single-phase furnace, which has installed in the circuit an external reactor which lowers the power factor, as stated before.

Book Reviews

PRINCIPLES OF RADIOTELEGRAPHY. By Cyril M. Jansky. New York: McGraw-Hill Book Company, Inc. 242 pages, 179 illustrations.

This is an elementary textbook on radio-telegraphy, addressed not only to college students of electrical engineering in their earlier years of study but also to technical students out of college. The principles are therefore discussed quantitatively in relatively simple mathematics, well supplied with arithmetical examples. The book is divided into eleven chapters, dealing respectively with the following topics: Magnetic phenomena, electrostatic phenomena, electromagnetism, units of measurement, electromagnetic waves, elementary alternating currents, oscillatory currents, radio circuits, practical transmitting appliances and methods, practical receiving appliances and methods, vacuum tubes and their use in radiotelegraphy.

A CALENDAR OF LEADING EXPERIMENTS. By William S. Franklin and Barry MacNutt. South Bethlehem, Pa.: Franklin, MacNutt & Charles.

This little book, bearing as its title a name coined by Francis Bacon, is an unusual production. Refreshing and bracing in its style and in its conception of science, it starts with a brief outline of the laws of motion, proceeds to experiments in dynamics, passing on to experiments in heat, electricity and magnetism, light, sound and wave motion. The authors are not provincial. Their scope of reading is indicated by casual references to the best works in science, and we are glad to see their energetic protest against the stupid "scienticulist" methods of teaching. There are excellent points in this book, like the experiments on "gyroscopic motion" and on "balancing" in the chapter on mechanics. The statement of the "laws of motion" is perhaps not altogether to our liking, as we feel that it is impossible to improve upon the plain statement of the three laws of motion by Newton himself, adhered to by Maxwell and by Kelvin and Tait. The chapter on heat is less full than we should have wished it. The best chapter seems to us to be the concluding one on the "Dynamics of Wave Motion." This is so suggestive and interesting that in this connection reference should be made to W. S. Franklin's book on "Electric Waves," which should be read by every one interested in physical phenomena, and especially by electrical engineers.

FIG. 10—SNYDER ELECTRIC FURNACE POURING CHARGE AND REACTOR IN CIRCUIT WITH IT

RAW MATERIALS USED BY ELECTRICAL MANUFACTURERS

List Presented at Meeting of Associated Manufacturers of Electrical Supplies in Connection with Study of International Trade Conditions

At last week's meetings of sections of the Associated Manufacturers of Electrical Supplies at New London, Conn., one evening general session was devoted largely to the subject of international trade. A table was presented by William Burgess, expert adviser to the international trade committee, showing the number of raw materials entering into products of the industry. The details of these different materials, divided according to classes, are printed below:

MINERALS, CHEMICALS, ETC.

Aluminum
Antimony
Asbestos
Alcohol
Asphalt
Borax
Benzol
Boracic acid
Carbon
  Graphite
  Granular graphite
  Amorphous carbon
  Carbon electrode
  Silicon carbide
  Carbon bisulphide
Carborundum
Chalk
  Whiting
  English cliffstone
Copper cyanide
Cobalt oxide
Chrome alum
Chloride of zinc
Ebony formure
Formaldehyde
Gelatine
Glass C
Glass
Glue
Iridium
Linstun
Lampblack
Litharge
Lithopone
Mica
  White (Ind.)
  Amber (Can.)
Marble
Mercury
Magnesia
Manganese dioxide
Petroleum coke
Plaster of paris
Portland cement
Phenol
Phosphor
Rosin
Slate
Soapstone
Sapphire
Sodium fluoride
Sal ammoniac
Sulphur
Sulphuric acid
Sulphate alumina
Sodium cyanide
Zinc oxide
Zinc anodes

Total, 58.

Various aniline colors.

WAXES

Holowax
Montana wax
Beeswax
Paraffine wax
Sealing wax
Japan wax
Carnauba wax
Wax tailings

Total, 8.

OILS

Linseed oil
Petroleum oil
Castor oil
Chinawood oil
Dead oil of coal tar

Total, 5.

METALS

Iron
  Cast
  Malleable
  Chromite
  Tungsten
Steel
  Nickel steel
  Cast-drop forged
  Pressed sheets
  Rods, strips, etc.
Brass
Bronze
  Phosphor bronze
Babbitt
Copper
Lead
  White lead
  Red lead
  Lead foil
  Tin foil
Silver
German silver
Solder
Platinum
Tin
Zinc
Nickel
  Nickel silver
  Nickel chromium
  Nichrome
Metal alloys, various kinds
Rutile
Lavite
Guilding metal

Total, 34.

RUBBER AND COMPOSITION

Rubber
Gum
  Impregnating gum
  Manila gum
  Cobalt gum
  Asphaltum gum
  Fossil gum
  Gum shellac
Condensite
Bakelite
Benolite
Micarta
Vulkebeston
Micanite
Paste
Vulcanized fiber
Rubber cement
Shoddy (reclaimed rubber)

Total, 18.

PAPER

Paper
  Baeren paper
  Fishpaper
  Rope-cement paper
  Wood-pulp paper
Rope paper
Fullerboard
Pressboard
Pulpboard

Total, 9

COTTON, WOOL AND SILKS

Cotton
  Thread
  Cord
  Yarn
Linen
Cambric
Cotton cloth
Silk, silk yarn, thread
Wool felt, yarn
Canvas

Total, 13.

PAINTS AND VARNISHES

Paint
Varnish
Shellac
Enamel
Japans
Pitch
Pine tar
Coal-tar pitch
Asphaltum
Benzine
Turpentine

Total, 11.

WOOD

Yellow pine
Fir
Hardwoods
Wood flour

Total, 4.

MISCELLANEOUS

Chamois
Hemp
Jute
Burlap
Fiber
Leatheroid
Celluloid
Capsules
Starch
Glucose
Clay
Crucible clay
Feldspar
Silica
Ball clay
China clay
Spar
Sand
Coal
Coke
Asbestos flour filler

Total, 21.

SUMMARY

Minerals, chemicals, etc	58
Waxes	8
Oils	5
Metals	34
Rubber and composition	18
Paper	9
Cotton, wool and silk	13
Paints and varnishes, etc.	11
Wood	4
Miscellaneous	21
Total	181

Lake Placid Convention of the A. I. E. E.

Work and Play Well Balanced—The Part Which Coöperation Can Play in Future Activities—System Protection, Technical and Development Committee Reports and Cable Problems Were Principal Business Features

THE ENGINEER'S PLACE IN THE WORLD PROBLEM

May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous coöperative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?—*From the presidential address of Prof. Comfort A. Adams before the A. I. E. E.*

WHILE the Lake Placid (N. Y.) convention of the American Institute of Electrical Engineers, held on Tuesday to Friday of this week, was primarily for business and professional purposes and was highly successful in this connection, its outstanding feature was the liberal provision for relaxation between the periods of convention work. No one who attended can help feeling that he had a delightful vacation, the natural facilities of Lake Placid affording all that any one could wish in the way of entertainment. The woods, mountains and lakes, the friendly spirit, the outdoor sports, dancing, automobile rides, etc., all contributed to the most successful convention which has been held for years. By Wednesday evening, the second day of the convention, the registration had reached 370.

The plan arranged for the convention period was to hold business sessions during the mornings only and leave the afternoons and evenings free for recreation. On the first morning, following President Adams' address, papers and discussions were presented on relay protection and on grounding the neutral. So much interest was evidenced in these subjects that the discussion continued well through the forenoon of the next day. Some of the technical committee reports were read and discussions on them took place on Wednesday morning, but a following session was necessary to complete the forenoon's program. One of the very interesting phases of the convention was the conference on Thursday morning under the auspices of the committee on development. The report of this committee will appear next week, with an account of the discussion on cable problems.

PRESIDENT ADAMS DISCUSSES MANY SUBJECTS

President C. A. Adams, in the opening address of the convention, called attention to the general unrest in all sections of the world arising out of the great war, which has led to a change in the old order of affairs. As to the future he asked: "Are we as engineers, educated men, who pride ourselves on our breadth of vision, who complain because we are not properly recognized in large questions affecting the public welfare, going to crawl back into our little cabins and leave the steering of the ship to those we consider incompetent, or are we going to scrutinize the ship's log to see why she ran on the rocks and then revise the sailing orders accordingly?"

From this Professor Adams took up the general subject of coöperation. He said that the history of human society is the history of coöperation and that every commercial transaction is made on the assumption of mutual benefit to both parties concerned. "The more the mutual confidence and the coöperative spirit, the freer and the more efficient will be the interchange and the greater the mutual profit," Professor Adams said. "This is merely the simplest possible illustration of cooperation to show its fundamental nature. Industrial coöperation, from which my illustrations are drawn and with which engineers are mostly concerned, usually involves more than this simple and somewhat restricted coöperation between buyer and seller; it involves cooperation all along the line, internal and external, between producers, between consumers, and between producers and consumers.

PRESIDENT C. A. ADAMS

"The obstacles to coöperation, particularly between the larger units, are of two varieties, material and human or intellectual. The chief material obstacles are space coupled with imperfect means of communication and transportation, differences in language, differences in coinage, weights and measures, and duties or tariffs. Some of these bear obviously only on international cooperation. The chief intellectual obstacles are tradition, custom, prejudice, suspicion, distrust, jealousy, narrow-

minded and short-sighted selfishness or greed, or in general ignorance and lack of understanding one of the other. Most of this latter group bear upon minor or internal as well as upon international coöperation."

COÖPERATIVE SPIRIT IN STANDARDIZATION

Professor Adams traced the connection between engineering and industrial standardization and coöperation, showing that as a result of standardization the confusing and conflicting claims of competing salesmen are eliminated because the purchaser is placed in possession of definite knowledge of the characteristics or capacities of machines, and thus is able to select discriminately and wisely. But this coöperative spirit apparently does not always prevail. The speaker continued: "Until very recently the French national committee of the International Electrotechnical Commission contained none of the designing or manufacturing engineers, it being assumed that the latter would be biased and partisan in their attitude. As a result the manufacturers formed a syndicate with a committee and standardization rules of its own, which were and even now are to some extent the rules generally employed in France, although much inferior to our own. In some cases the American rules are specified. Even now the French rules originate in the manufacturers' syndicate and are passed on to the French national committee for its approval with a consequent loss of time and efficiency.

"As the work of our own standards committee expanded we found it overlapping the work of other societies in adjacent fields, and coöperative relations were established. This failed from the lack of any suitable and generally acceptable coöperative machinery. A movement was then started by the Institute, more than two years ago, to organize a central body (the American Engineering Standards Committee) to coördinate all the work of engineering standardization being done by the various engineering organizations. The objects of this organization are to avoid overlapping, duplication of effort and the confusion of conflicting standards; to insure the employment of an effective and sound procedure in the development of standards, to the end that a standard when promulgated may be not only workable but also acceptable to all concerned and the only accepted standard of its kind; to stimulate desirable standardization and at the same time to shut off premature or ill-advised attempts at standardization.

"The consummation of these objects will mean an enormous saving of effort in the production of standards, a tremendous increase in the value and usefulness of standards, and, when the work is brought up to the needs of the time, an incalculable saving in the cost of production and the productivity of labor. International standardization," Professor Adams went on to say, "will be a tremendous stimulus to foreign commerce; but such international standardization is in most cases exceedingly difficult without a central authoritative body with which similar foreign bodies may coöperate. Several instances of this difficulty which have actually arisen during the past two years could be cited. These have resulted in hopeless confusion, misunderstandings and waste of time and money.

"Great Britain has its Engineering Standards Association, which during its eighteen years of life has demonstrated its reason for existence and its value to industry and to the government. The work in air craft standards alone which it is doing on behalf of the government involves some fifty odd sub-committees. France now has its permanent Standards Commission, a little more than a year old, and just getting under way. Holland also has its Normalization Bureau for the same purpose, and Switzerland is just starting a movement in this direction.

"With all these national bodies our American Standards Committee has already established cordial coöperative relations. The American Engineering Standards Committee, although organized last October, is now in process of reorganization; but the success of any such movement is in direct proportion to the degree in which the coöperative spirit prevails. It is the fear rather than the fact that causes the trouble. Even if the sacrifice were much more than it is, however, the price would be small in proportion to the result.

"It is the generous coöperative spirit for which I am pleading, rather than the timid spirit of him whose vision is of such short range that he dare not take a man's size step for fear of stubbing his toe, who holds the little present so close to his eye that it shuts out the whole landscape of the future, whose immediate self-interest or small-group interest is so dominant as to hide anything beyond.

INDUSTRIAL RESEARCH

"Another fertile but as yet little cultivated field for coöperation is that of industrial research. Here we have a field where the obstacles of the second group are specially dominant—particularly short-sighted self-interest and corporate interest and the timid desire for secrecy. That many of the most important and revolutionary developments of modern industry are dependent upon research needs no proof. It is not so obvious to many, however, that coöperation in industrial research is to any large extent feasible at the present time.

"After some experience in this field I am convinced that thorough-going coöperation in industrial research would mean not only a reduction of the cost of research to a small fraction of its present figure, a much more rapid industrial development of the country as a whole and a material increase in the productivity of labor, but also an increase in the profits of every intelligent party to the coöperation.

"Serious coöperation of any kind between widely separated groups is practically impossible without the mechanism of transportation and communication provided by the work of the engineer. Also, with this mechanism developed even to its present degree of perfection, coöperation becomes not only possible but also desirable and necessary, even between comparatively widely separated groups. Moreover, the problems which confront the world at this time are largely a direct result of this mechanism. Are we as engineers going to leave their solution to others? Are we going to be satisfied to play alone in our own little back yard and never look around us even after most of the fences have been removed by our own work? Are we going to fail to take an interest in our neighbor who has much that we need, from whom we have much to learn, and by coöperation with whom we can profit broadly? If we do offer coöperation, is it to be with the provision that we gain all and sacrifice nothing? Are we going to be

satisfied to sit back and criticise destructively the details of a coöperative agreement, priding ourselves on our critical faculty, however valuable that may be at times, when the real basis of the criticism is either intellectual pride or short-sighted fear that we, as individuals or as a group, may lose a little of our independence or prestige; when the issue at stake is in some cases of such paramount importance even to us as individuals (had we only the vision to see it) as to overshadow our very existence?

"Let us rather make use of the logical habits of thought and freedom from bias which at least should be the result of our training and take our part in the solution of the problems we have helped to create. Let us see the goal ahead and start for it without thought of fear or favor, as sure-footedly as possible, but with that generous coöperative spirit which will surmount many an apparently impossible barrier, critical of details if so minded, but generously and constructively so."

Labor and Other Monopolies

Professor Adams then touched upon the serious problems arising from the worldwide unrest in the labor group. He said: "It is very easy to criticise and condemn this attitude because of its unreasonableness, looking down from our superior height of intelligence. It is very easy to assume that it is merely a matter of showing the laborer the error of his ways and of forcing him into line. But would it not be wiser at this time to examine our own attitude with equal care, to make sure that we are setting an example which if followed by labor would solve the problem? Is demanding all the traffic will bear under the pressure of organized labor any worse than the same policy carried out by the capitalist whenever he has the monopoly grip? Unfortunately the two cases are not treated the same by our laws. Labor monopoly is not subject to the same limitations and responsibilities as is capital monopoly. That disparity should be removed. But there are two forms of monopoly other than of labor which are not only not limited by but are actually fostered and protected by our laws, and in which the only limitation ever dreamed of by the owner is 'all the traffic will bear.' These are patents and titles to land."

Professor Adams explained these monopolies at length and showed that is was incumbent on the engineer to assist in a progressive rational evolution of society rather than encouraging and inducing a revolution by a reactionary policy.

The Engineer as a Citizen

"Are we sincere in our desire to be more recognized in our broader capacity as citizens and to be consulted in matters of broad public interest if we are not sufficiently interested in those matters to make an intelligent study of them—if we are satisfied to accept without analysis the prejudices and propaganda of a biased group, however intellectually superior that group may consider itself—if we cease to utilize our logical habits of thought, our habit of analysis, of demanding the reason why, as soon as we step outside of the realm of those physical laws which force us to think straight? Are there no laws in this other realm of human relations which are just as inexorable as the physical laws with which we are so familiar? Is there no law of compensation which is the counterpart of our law of conservation of energy? Are we going to be allowed to go unpunished for crooked or careless thinking in this other realm any more than in the purely physical realm?

"What can we expect of labor in the way of intelligent fair-mindness if we, with our superior advantages, encourage the perpetuation of institutions which work for serious injustice to the many for the benefit of the few, or even if we allow them to persist because of our lack of intelligent fair-mindedness?

"My opinion as to the seriousness of the present world situation, as to the importance of the problem before us, is not mine alone but that of many thinking men in this country and in others. I have talked with many influential men in France and England and have found a striking unanimity on this point.

"May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous coöperative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?"

DISCUSSION AT TUESDAY MORNING SESSION

The president-elect, Calvert Townley, in responding to President Adams' introduction, expressed his appreciation of the honor conferred on him and especially of the opportunity for leadership. He contended that the engineers should be just as able to be prominent in the public eye during peace times as they have been during the last few years in helping to carry the war to a successful conclusion. He could not see any far-reaching danger in the present labor agitation because he declared that any body which seeks to secure more benefits than are due it cannot succeed.

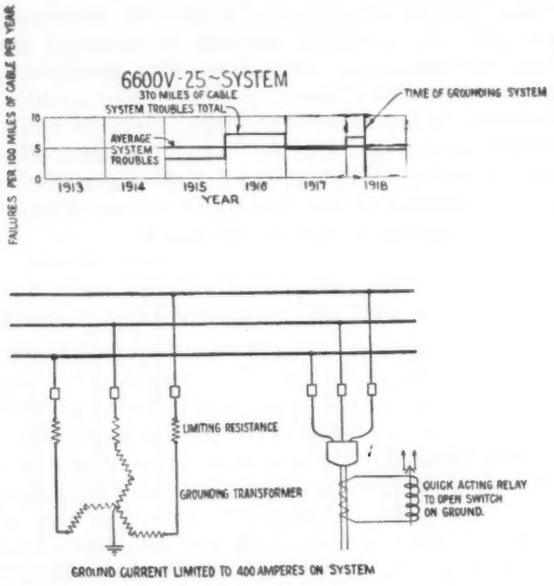
The first paper of Tuesday morning's session was presented by H. R. Woodrow, D. W. Roper, O. C. Traver and P. MacGahan on "Present-Day Practice of Transmission and Tie-Line Protection," an abstract of which begins on page 1375 of this issue.

Two papers on grounding the neutral were presented at the same session—one of them by H. R. Woodrow and the other by William E. Richards. In the paper by Mr. Woodrow, it was said that experience had shown unquestionably that the cable stresses are considerably relieved by grounding the neutral. Further, it is believed that it is desirable to limit the grounding current as much as possible, thereby reducing the stresses on the system, and particularly the burning of the lead sheath and grounding connections. The installation of grounding relays, which can be set to disconnect a feeder more quickly than the straight normal-current relays, will further greatly relieve the potential stresses due to prolonged grounding current which occur even with a grounded system.

In Toledo, where about 16,000 kw. is transmitted over 23,000-volt, 25-cycle transmission circuits connected with underground cable, considerable improvement in operation has been observed since changing from an ungrounded system to a directly grounded Y system, Mr. Richards said in his paper.

All of the papers presented at the Tuesday morning session were on allied subjects—namely, relay protection and grounding of the neutral—so the discussion of

these papers was taken up at the same time. Among those taking part in the discussion were the following: H. B. Vincent, Day & Zimmerman, Philadelphia; J. R. Craighead, General Electric Company, Schenectady; J. A. Johnson, Ontario Power Company, Niagara Falls; A. H. Lawton, Consumers' Power Company, Jackson, Mich.; H. C. Albrecht, Philadelphia Electric Company, Philadelphia; Philip Torchio, New York Edison Company, New York; P. M. Lincoln, Westinghouse Electric & Manufacturing Company, Pittsburgh; Charles Proteus Steinmetz, General Electric Company, Schenectady, N. Y.; E. T. Moore, Halcomb Steel Company, Syracuse, N. Y.; F. D. Newbury, Westinghouse Electric & Manufacturing Company, Pittsburgh; W. de L. Carr, United Gas Improvement Company, Philadelphia; R. F. Schuchardt, Commonwealth Electric Company, Chicago; E. F. Creighton, General Electric Company, Schenectady; Don Carlos, Ontario Power Company; E. A. MacKenzie, Ontario Power Company; R. R. Honaman, Bureau of Standards, Washington; E. G. Merrick, General Electric Company, Schenectady, N. Y.; F. L. Hunt, Turners Falls Power & Electric Company, Greenfield, Mass.; D. W. Roper, Commonwealth Edison Company, Chicago; P. H. Adams, Public Service Electric Company of New Jersey; A. E. Silver, Electric Bond & Share Company; F. C. Hanker, Westinghouse Electric & Manufacturing Company, Pittsburgh; J. C. Parker, University of Michigan, Ann Arbor; D. C. Traver, Schenectady, and H. R. Woodrow, New York Edison Company.



GROUNDING SYSTEM THROUGH ZIGZAG-CONNECTED TRANSFORMERS

Results obtained by connecting limiting resistances in the primary side of the grounding transformer. Limit total of ground current with both generating stations operating in parallel to 400 amp.

TUESDAY'S DISCUSSION ON RELAY PRACTICE

Considerable of the discussion centered around the terminology used in connection with relay practice, some even objecting to the classification of devices given by the protective devices committee.

Mr. Craighead declared that the future practice in designing or extending transmission lines should take into consideration the principles of protection as well as economy. Furthermore, increase in speed of operation of oil switches has required a corresponding improvement in relays. By so doing he believes it will be possible to reduce the time differential of delays below the three-fourths of a second which is now believed to be the minimum. One of the greatest opportunities for improvement will be through the thorough understanding of operating conditions by actual measurements of current, etc.

Mr Johnson expressed the belief that improvement could be made on combined use of under-voltage and over-current relays, mentioned in Mr. Woodrow's paper and abstracted elsewhere in this issue, by letting the under-voltage relay control the current supplied to the tripping bus. This scheme has been used at Niagara Falls in the generator neutral and is worthy of more application, he contends. Greater improvement in circuit breakers will have to be looked to in the future for isolating cable faults.

At Philadelphia the cycle counter is used extensively, said Mr. Albrecht, for timing and setting relays. A differental of 25 cycles is allowed for relays, 15 cycles being allowed for the oil switch to operate and 10 cycles for inaccuracy of relays. He expressed the opinion that it is impracticable and expensive to test on the primary side of current transformers as suggested in Mr. Woodrow's paper and declared that too much emphasis is placed on the reduction in busbar voltage during short circuits.

Mr. Torchio admired the ideal which Mr. Johnson looked to—that is, a circuit breaker which would open any short circuit—but said it is too far in the future. The better way to do, in his opinion, is to reduce the amount of power that can go into a short circuit in order that the selective relays can be properly applied. He contended that it is better to follow this American development than to change to European practice.

With the increase in size of electric service systems, Mr. Lincoln pointed out, the possibility of interruption of service is increasing, and at the same time there comes a greater need of reliable service. Hence there is an extraordinary need at this time and in the future for considerable investigation of the protection of large systems in order to offset these contending factors. In this connection it is encouraging to note that the efficacy of grounded neutrals is fairly well demonstrated, the Toledo, New York and Montana companies having reported favorably in this connection.

The problem of relay protection, said Mr. Steinmetz, is the production of simple, reliable and automatic apparatus that will permit an abnormal circuit, cable or piece of apparatus to be disconnected without interfering with the operation of any normal line or cable. When disturbances occur normal circuits as well as the circuits in which the disturbance takes place are affected, so that devices that indicate or act merely when abnormal conditions take place will not solve the problem because the conditions require a device whose operation depends on the magnitude of the abnormality.

Mr. Moore called attention to the need of further study in the adaptation of relays to electric furnace protection.

Mr. Newbury was particularly pleased to hear operators speak favorably of a grounded neutral because this is desirable to machine and apparatus designers.

Mr. Schuchardt pointed out that it has taken a long time for engineers to recognize that relays reduce investment expense, due to the saving possible through interconnection. Now, he contended, it is a case of pro-

viding the proper talent to maintain relays in order that the manufacturers may know where further improvement is necessary. To permit an interchange of information on this subject he suggested that the protective devices committee serve throughout the coming year as a clearing house on experiences with relays. Although Chicago has a larger system in a limited territory than probably any other company, the conditions met there may be the same as those of other systems in the near future, so their problems and solutions are worthy of considerable study by such companies. On this system the circuits are sectionalized by reactors to limit the power which can be supplied to any fault. In each section one unit is grounded through a 2½-ohm resistance.

In closing the discussion Mr. Creighton pointed out that balanced relays sometimes trip when circuits are being synchronized owing to the switch blades failing to make contact simultaneously. While the arcing ground suppressor was very effective when used on radial systems, it is not at all satisfactory now on parallel factors.

CONTINUATION OF DISCUSSION WEDNESDAY

Mr. Carlos questioned the need of such a small total time interval as two seconds in relay setting, saying that on the Ontario Power Company's system a total interval of eight seconds is allowed, while on an associated system four seconds is maintained without trouble, owing to the long time setting. The setting of three-quarters second between relays could not be maintained with satisfactory results, he said, at least double that time being necessary with the equipment used.

Mr. MacKenzie said that automobile batteries of both the lead and Edison types have been used for operating relays and that the lead type appears to be more economical for this particular purpose, although dry cells are still more so. The latter are being used by some companies even for 110-volt oil-switch control. He recommended Mr. Johnson's method of using under-voltage relays to control the tripping bus in conjunction with over-current relays, a master relay being employed for a similar purpose on the Ontario system with satisfactory results. For generator protection Mr. MacKenzie favored using definite-time relays. He does not consider it necessary to set relays from the primary side of the transformer and recommends testing them after each automatic operation for characteristics, including minimum current required to operate them. The latter should not be appreciably above the operating load.

Mr. Merrick considered that it is hardly necessary to reduce the total operating time of relays and switches below two seconds to protect generators and transformers, since they can withstand short circuits for several seconds anyway. On the Montana Power Company's system higher reliability of relay operation has been obtained by grounding neutrals, practically the only trouble now experienced being due to the high resistance of grounds which prevent relays tripping.

A total time interval of three or four seconds is allowed on the relays used on the Turners Falls system, said Mr. Hunt. Since grounding the neutral the results have been more positive than ever before.

The New Jersey company, declared Mr. Pollard, has come to the decision that grounding the neutral is better than not doing so. This is particularly interesting since the company operates about 200 miles of cable and 300 to 400 miles of overhead lines. Where the stations are in tandem one-half second interval is allowed between relays, which are the induction type, and three-quarters second should certainly be amply satisfactory. In addition to the ordinary type cables, this company operates twelve split-conductor cables which have given very satisfactory results.

Mr. Roper said that the Commonwealth Edison Company has conducted some tests which show that synchronous apparatus will be thrown out of step when a short circuit occurs very near the equipment if the relay action is not very rapid. However, if the short circuit occurs 100 ft. to 200 ft. (30 m. to 60 m.) away, thereby increasing the reactance and resistance of the circuit, this trouble will not be experienced so acutely if the relays and switches operate properly. Since the effect of burn-outs in cables and the spreading of damage is more severe when time element is introduced into relays, it is very important that rapid relay action be obtained to prevent this trouble.

Mr. Adams expressed the belief that a total time interval of two seconds might be the right value to maintain in relay settings for short-circuit conditions. but it does not need to be so long for mere overload conditions.

On systems which the Electric Bond & Share Company has been operating it has been found that very much better relay operation is obtained when the neutral is grounded, according to Mr. Silver. These experiences have been in connection with circuits operating at voltages of 60,000 and upward.

Mr. Hanker recommended the extension of investigations of relay application of grounded systems by the protective devices committee

Relay application should not be considered so much from the viewpoint of protection of apparatus, said Mr. Parker. as from that of insuring continuity of service. If this distribution is made, the problem of determining time settings is considerably simplified. Too often engineers fail to recognize the ultimate object of central stations, which is to give continuous service. To illustrate the penalty which has to be paid if this is not done, Mr. Parker cited one instance in which a company lost about $500,000 of revenue from two consumers through failure to eliminate interruptions. This loss is large enough to justify spending considerable money on relays. The moral is not to wait for perfect devices to be developed before providing protective means but to use those already available in the best manner possible.

Mr. Traver entered a plea for using high turn (300 or so) ratio for bushing transformers, because the accuracy is liable to be very poor otherwise.

Mr. Woodrow closed the discussion on relay protection and grounding neutrals by replying to comments made during the discussion and supplementing points brought out in the papers. He emphasized the fact that the time interval between relays depends on several factors including the characteristics of the relay, the time required for switch operation, and the nature of the system of which the apparatus is employed. While some of the more recently developed oil switches have a speed of operation as high as one-quarter to one-half second, others are not so rapid, so the time interval of three-quarters second is not so far wrong, he contended. Until high-speed breakers are developed there is no

AT THIS WEEK'S CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT LAKE PLACID,

way of reducing the time interval near the generators, although this would be desirable. On large systems it may be possible and desirable to reduce the total time interval below two seconds, although on smaller systems it is permissible to allow a longer interval. Referring to the possibility of synchronous apparatus falling out of step, Mr. Woodrow pointed out that the tendency to fall back into step again will not be so great if the time interval is increased. Comparing single-turn and multiple-turn current transformers, Mr. Woodrow pointed out that the former are very accurate on overloads, but that the accuracy depends greatly on the secondary load. This load may cause the speed to range from one-half to three-quarters second. For this reason it is advisable to use the primary-test method recommended instead of applying current directly to the relay terminals. The next best method, so far as accuracy of results is concerned, is to apply the test on the secondary terminals of the current transformer. Testing beyond the flat part of the relay characteristic curve is not essential, in Mr. Woodrow's opinion. Unless current is limited considerably by reactors, Mr. Woodrow believes eight seconds is rather long for the total time interval because all apparatus will not withstand full short-circuit current the way some people believe. In addition to using short-circuit protective relays, the company with which Mr. Woodrow is connected employs ground relays to clear faults before they develop into short circuits.

REPORTS OF TECHNICAL COMMITTEES

Despite the press of war work during the last year, the technical committees were able to gather important information and the reports show that considerable time and thought were spent in learning the conditions in the industry. Brief outlines of these reports are given below.

COMMITTEE DISCUSSION OF INSTITUTE PAPERS

In reporting the activities of the power stations committee Philip Torchio, chairman, advocated a revision by which it is hoped to improve the character of discussion of A. I. E. E. papers and even the papers themselves. He thought that the Institute papers should be fully discussed by each committee before being presented to the membership. The committees should discuss any necessary revision and help to get the paper in the best form before its presentation at a general meeting. The committee will then stand behind this paper, and the discussion brought out will be more fully considered. It is suggested that in some instances the work of the committee may well be broadened to the extent of sometimes invading the field of other technical societies and committees of the Institute where it is thus necessary to make a comprehensive study of the subject. For example, the power stations committee has under consideration three papers to be prepared on the subject "Limits of Speed and Power of Single-Shaft Steam Turbo-generator Units." Two of these will deal with the mechanical end of the unit and one with the electrical end. While in a way this work might overlap that of the American Society of Mechanical Engineers or similar societies, still the features of engineering and design of machines can be discussed only constructively with the coöperation of the users and the assistance of engineers thoroughly familiar with calculation and design of machinery. For future activities of the committee the chairman proposed a paper outlining the statistical items which are essential in reporting efficiencies of power plants, a comprehensive review of the relative merits of shunt and compound-wound exciters, steam and motor-driven exciters, etc.

Following the presentation of Mr. Torchio's report, President Adams called attention to the importance of the suggestions made by Mr. Torchio, saying that considerable benefit will result to all concerned if the papers committee will coöperate in the future with authors in presenting concise, accurate and suitable information in Institute papers.

Professor Slichter of Columbia University, chairman of the papers committee, pointed out that national meet-

N. Y., ABUNDANT OPPORTUNITY WAS PROVIDED FOR DISCUSSION AND FOR RECREATION BETWEEN SESSIONS

ings in the future will be still more dignified than in the past, and hence greater care than ever must be exercised in selecting papers.

ELECTRICAL APPLICATIONS IN INDUSTRY

Each sub-committee of the industrial and domestic power committee concentrated its efforts on its branch of the work and subdivided its activities into the application of electric power to specific processes and the application of electric power to specific electrically driven machinery. A brief statement was given of the work planned by the sub-committees on the printing industry, the elevator industry and machine-tool applications. An excellent paper was presented by R. B. Williamson, as a result of the work of the sub-committee on the cement industry. H. G. Pierce, chairman of the committee, recommended that the personnel of this committe be kept intact and the work be continued in the way it has been started.

CONSIDERABLE PROGRESS MADE IN TELEPHONY

Donald McNicol, chairman of the committee on telegraphy and telephony, stated that during the last year considerable improvement has been made in the design of lightning protective apparatus for the protection of telephone and telegraph lines. Some progress has been made in coöperation between power companies and telephone companies in the solution of problems arising out of inductive interference. For the improvement of long-distance telephone transmission, the vacuum-tube amplifier has been highly developed for use in telephone receivers and has become the preferred form of amplifier used.

THERMOCOUPLES FOR A. C. MEASUREMENTS

The activities of the committee on instruments and measurements said S. G. Rhodes, chairman, during the last year have been principally in connection with the Bureau of Standards, working with the War Department to standardize purchasing specifications for electrical instruments for overseas service. Among the interesting developments in this work have been development of thermocouples for accurate measurements of alternating currents of any frequency. These are greatly improved over former German instruments which were on the market.

SHIP ELECTRIFICATION INCREASING

As a result of shipbuilding activities brought out by the war, the marine committee has been divided into two parts, a ship installation committee and an electric ship propulsion committee. The ship installation committee, moreover, was further subdivided into a power apparatus committee, a lighting committee and a distribution committee. H. A. Hornor, chairman of the committee, suggests five items which have been taken up by the power apparatus and the lighting sub-committees but not considered by the main committee, as follows: Control equipments, alternating-current apparatus control, radio installation, running lights and fire alarms.

NEW POWERFUL SEARCHLIGHT DEVELOPED

Now that war-time restrictions have been raised from street lighting considerable activity is expected in this direction. C. E. Clewell, chairman of the committee on lighting and illumination, says there is an increased tendency to apply some form of prismatic reflector to incandescent street lighting. Interesting developments in lighting have been brought about by the requirements of searchlights during the war and the development of the so-called Lynn searchlight, said to be the most powerful searchlight in the world. Moreover, the spectrum of the light which is derived from these units is of the daylight character.

AIM TO BETTER PHYSICIST AND ENGINEER RELATIONS

The aim of the committee on electrophysics has been: (1) To encourage original papers of a high technical standard, marking advances in electrophysics; (2) to have each year a broad, interesting general lecture, free from mathematics, dealing with modern physics; (3) to promote a more complete coöperation and mutual understanding between the engineer and physicist. F.

W. Peek, Jr., chairman of this committee, suggests general lectures on electrophysics for the purpose of keeping engineers in touch with this work.

MOVE TO STANDARDIZE EQUIPMENT

By far the largest amount of electrical energy required in any one industry is used by the iron and steel industry. The motor equipment requires 650,000 kw. in generator capacity, and electric furnaces about 250,000 kw., or a total of 900,000 kw.

Particular emphasis is laid upon the possibilities of standardization by the chairman of the iron and steel industry committee, E. Friedlaender. In this connection coöperation with the Association of Iron and Steel Electrical Engineers is essential. Mr. Friedlaender states that the Institute should go considerably further than it has in the past in the matter of standardizaion and extend its work to standardize mechanical dimensions, shafts, gears, pulleys, etc., as desired by the American Iron and Steel Electrical Engineers.

URGES APPARATUS PROTECTION RESEARCH

The work of the protective devices committee is largely set forth in a paper dealing with a relay questionnaire presented at the convention. D. W. Roper, chairman of the committee, recommends that similar investigations be carried out on the following subjects, in order of preference: (1) Schemes of relay protection; (2) oil circuit breakers; (3) grounding of the neutral; (4) lightning arresters; (5) current transformers; (6) potential transformers. The necessity of coöperation and mutual understanding of research problems should be fully understood by operating companies.

ELECTRIC SERVICE MEMBERS IN WAR SERVICE

The committee on economics of electric service, as reported by William B. Jackson, chairman, did not function during the year on account of the fact that the chairman and several members were in the military service.

RECOMMEND COÖPERATION WITH CHEMICAL SOCIETY

In connection with many electrochemical and electrometallurgical plants there are features of purely electrical character, such as regulation, power factor, load factor, balancing of loads, different kinds of currents, etc., which chemists and metallurgists are not qualified to discuss. Papers of that character should go to the A. I. E. E., or, better yet, be presented at joint meetings of the A. I. E. E. and the American Electrochemical Society. The chairman of the committee on electrochemistry and electrometallurgy, Carl Hering, recommends that this plan of mutual coöperation between the societies be fostered.

INSULATORS AND CABLES CAREFULLY INVESTIGATED

The transmission and distribution committee has been quite active during the past year and has dealt particularly with high-tension insulators and underground cables. Aside from the results set forth in several papers developed by this committee, it is pointed out that a proper appreciation of the factor of depreciation of insulators will go far toward improving operating results. There is little doubt of the tendency to go to considerably higher voltages wherever there is sufficient load to warrant a conductor large enough in diameter to keep down the corona losses.

For future activities of this committee, E. B. Meyer, the chairman, asks for more research work in the determination of dielectric losses in underground cables and standardized methods of testing. He also suggests that more data are desired on the question of the safe operating temperature of cables.

MUST WORK WITH MINING ENGINEERS

In suggesting future activities of the committee on the use of electricity in mines K. A. Pauly, chairman, suggests closer coöperation between various technical societies, national and local. Several papers were presented at the Institute meetings on mining questions.

MIND TEST FOR ENGINEERING STUDENTS

In commenting on the activities of the educational committee, Prof. V. Karapetoff, chairman, stated that at one time during the war there was considerable talk about radical changes in technical education, but it appears that colleges of engineering are essentially going back to the pre-war standards, methods and curricula. One important contribution of the war to the problem of education has been the introduction of elaborate psychological tests for analyzing a person's intelligence, fitness and caliber for a particular kind of work. Some leading universities have either introduced this system to test students or are planning to use it in addition to regular examinations.

ENTERTAINMENT FEATURES

The situation of the Lake Placid Club was ideal for the carefully planned programs for golf and tennis under the direction of A. M. Schoen of Atlanta for the golf tournaments and of G. A. Sawin of Newark, N. J., for tennis. The Mershon golf trophy was again offered, with the prospect that the final score on Friday would call for the addition of another new name. The following names are already engraved on it: A. M. Schoen, 1913; J. C. Mock, 1914; E. W. Allen, 1915; L. F. Deming, 1916. In order to secure the cup as a permanent possession, it must be won twice by the same contestant. For Thursday the annual baseball game was scheduled with W. A. Hall of Lynn, Mass., in charge.

For the ladies a special entertainment program was arranged. It included automobile trips each day, boat trips around Lake Placid, golf, cards and dancing. The automobile trips through the beautiful drives in the sections surrounding the Lake Placid Club, under the direction of W. L. Merrill, were made possible by members who contributed their cars for the purpose. On Tuesday afternoon a delightful piano recital and interpretation of Schumann's "Carnaval" was given by Prof. Vladimir Karapetoff. To the winners of the various games and highest card scores eighteen silver cups and thirty-two other prizes were offered.

A noteworthy feature of the entertainment and a finishing touch was added by a brass band of about thirty pieces made up of engineers of the General Electric Company, led by J. B. Taylor, assisted by two of his sons. Besides Mr. Taylor, who is a vice-president of the A. I. E. E., Past-vice-presidents Robinson and Merrill were conspicuous and effective figures.

Great credit is due to the convention committee, on which Farley Osgood, of Newark, N. J., served as chairman, for a type of program that provided a place for the play instincts of amateurs as well as the professionals and offered as well an opportunity for the ladies and others to see and enjoy the natural beauties of the Lake Placid district.

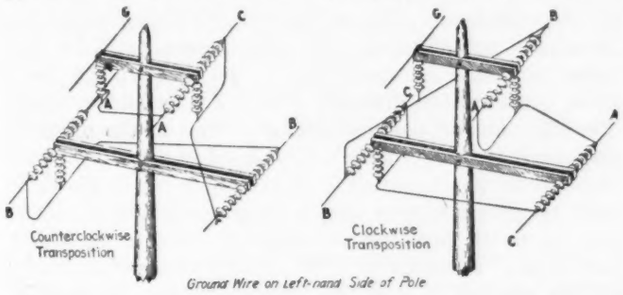
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SINGLE-POLE TRANSPOSITION FOR HIGH-TENSION LINES

Combination Dead End and Transposition of 120 Deg. Made with Solid Wire Jumpers Held by Suspension Insulators

A method of making a combination dead end and transposition of 120 deg. was described by D. F. Parrott of the Minneapolis General Electric Company before a meeting of the Minnesota State Electrical Associ-



CONNECTORS MUST NOT BE LESS THAN NO 2 B & S. GAGE TO MAINTAIN STIFFNESS

ation some time ago. Illustrations of this one-pole transposition with jumpers of solid wire equal in size to the line wires are shown. The minimum size of wire for jumpers in this type of construction is No. 2 B. & S. gage. Any smaller wire will prove too flexible to hold the original position which is given to it.

ECONOMICAL METHODS OF FIRING COAL IN FURNACES*

Fire Should Be Replenished When Bed Falls Below Normal Instead of Waiting Until Steam Falls—Lump Coal Should Be Broken Up

During the war there were several agencies which advocated economies in the boiler room in order to allow more fuel to be diverted to the war industries. Effecting these economies is just as essential now on account of the continued high cost of coal and the scarcity of good coal. One of the greatest economies can be effected in firing by keeping a uniform fuel bed at all times. The time to replenish the fire by adding coal is when the fuel bed has burned down below the normal standard and not after the steam pressure falls.

In using mine-run or lump coal the lumps should be well broken up. With screenings or the fine portion of mine run the coal will cake, and these caked masses should be carefully broken, on the top, after the cake has formed. This should be done with a light rake, but the fire should not be stirred or poked. The coal should be evenly spread over all the surface of the fire, giving special attention to the side and corners and always maintaining a good strong, hot fire. While a good fire bed should be maintained, care should be taken that it does not get too thick.

A good strong fire may make too much steam if the draft is strong. Therefore draft dampers on each boiler should be adjusted as often as necessary to keep the fire in the proper state. The steam pressure should be controlled by the draft, because the speed at which the fire burns or at which the heat is produced is dependent upon the amount of opening given the damper.

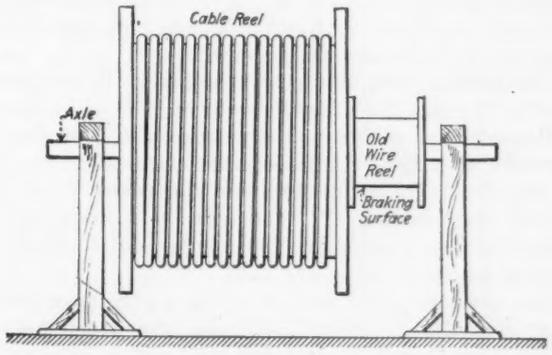
When fires are banked at night the draft should be cut off so that the bank will lie without burning. In the winter time, when steam is needed for heating, the same kind of fire should be maintained as in the day time, and the draft should be controlled in the same manner as during the day.

*This information was contained in a weekly letter from the Illinois Fuel Administration.

CABLE-DRUM BRAKE MADE BY THE USE OF OLD REEL

Weight of Cable Hanging in 80-Ft. Shaft Was So Great that Ordinary Braking Methods Might Not Have Prevented Unreeling of Cable

When the Cleveland (Ohio) Electric Illuminating Company was laying heavy cable in a deep tunnel the construction force needed an effective method of applying a brake to the cable reel. The weight of the



OLD WIRE REEL ATTACHED TO CABLE DRUM SERVES AS BRAKING SURFACE

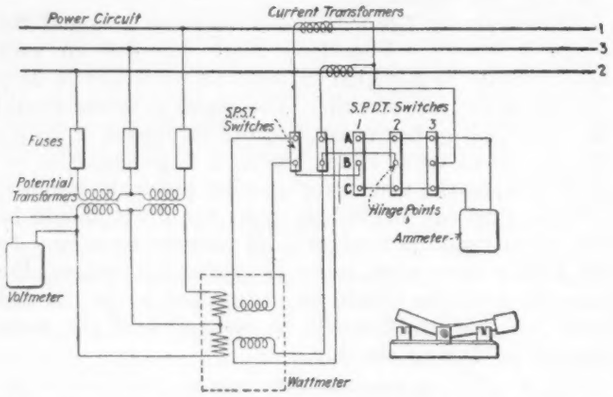
cable hanging in the vertical shaft, which was 80 ft. (24 m.) deep, was great enough to unreel all of the cable if the drum became unmanageable. The ordinary method of applying a 2-in. by 4-in. (5-cm. by 10-cm.) piece of lumber to the periphery of the drum was not considered sufficiently effective so a better braking surface was obtained by placing a small reel on the same shaft with the cable reel and attaching it there. A heavy scantling arranged to be held securely against the surface of the smaller reel served as a brake. This

attachment was easy to make, and the cost was extremely low because nothing had to be purchased for its construction.

IMPROVED POWER FACTOR RESULTS FROM INVESTIGATION

With Simple Testing Apparatus Central Station Has Been Able to Show Customers Advantages to Be Gained

In connection with a thorough investigation of the power-factor conditions obtaining over its entire plant and distribution system, the Springfield (Ohio) Light,



BROKEN-BACK SWITCHES PREVENT SECONDARY OF CURRENT TRANSFORMER FROM BEING OPENED

Heat & Power Company has devised the following scheme for determining power factor:

Three single-pole, double-throw 15-amp. knife switches were provided with a blade extension which makes them similar to broken-back switches. When placed in a single ammeter circuit, as shown, they eliminate the possibility of the opening of the secondary of the current transformers at any time and indicate the current flowing in each leg of a three-phase circuit. Properly combined with simultaneous voltages,* these readings give the kva. of the system.

The normal position of the switches, with no current flowing through the ammeter, will be *A-B*. Closing the switches one at a time to the position *B-C* will give the currents flowing. A three-phase wattmeter inserted in the circuit gives the kw., and the power factor can thus be determined. For convenience in inserting and removing this wattmeter, two single-pole, single-throw 15-amp. knife switches are used.

The two-wattmeter method, using a polyphase instrument, was first tried out, but soon abandoned because of the fact that in most cases the load is unbalanced. However, this method is used to some extent for testing individual motors.

Tests have been made of all power circuits, both generator and feeder, at the power station and of most of the primary meter installations of this company. A number of the larger power customers whose load had a low power factor are rearranging their induction motors to load them up and reduce the connected horsepower, and in two cases synchronous motors are being installed. One company in particular is installing a 300-hp. synchronous motor and a 100-kw. synchronous converter, the former to displace a steam engine, the latter to provide direct current for variable-speed drive. This customer has a fifteen-minute demand of about 150 kw. at 65 per cent power factor, which with the new demand will be increased to approximately 95 per cent.

The power contracts of this company contain no power-factor clause, so that all changes are being made on the basis of reduced motor horsepower, decreased losses and improved service.

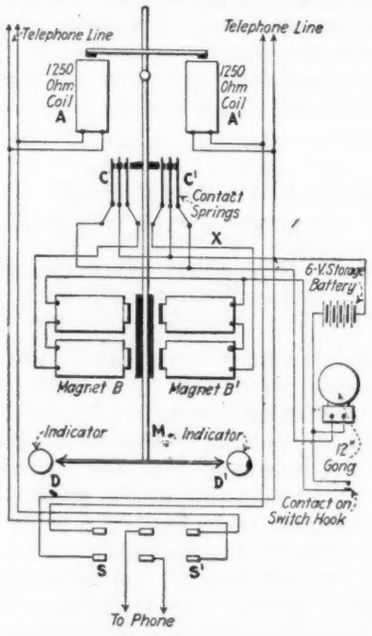
L. E. BROWN,
Springfield, Ohio. Superintendent of Distribution.

*In the cases investigated, the voltages were never sufficiently unbalanced to introduce serious error in kva. measurement.

POWER-HOUSE SIGNAL FOR TELEPHONE CALLS

Sensitive Relay Actuated by Ringing Current in Either of Two Telephone Lines Causes Closing of Contacts of Magnet, Operating Loud Bell

Excessive noise in power houses caused by rotating machinery often makes it difficult to get the operator on the telephone. The ordinary bell-ringing apparatus is usually not effective, and some means must be provided to have a constant-ringing bell that will be heard at a considerable distance from the telephone booth. The efficient and positive method shown in the diagram has eliminated all trouble of this kind in a station which has two telephone circuits. A 1250-ohm coil is placed in each telephone line so that a ringing current in either will cause the armature *M* between them to close contact *C* or *C'* respectively. This action closes the circuits of the magnet *B* and the bell, which are in parallel, energy being supplied by the 6-volt storage battery. When the operator answers the telephone the arrows at *D* indicate which line is calling, and he throws the switch accordingly. Lifting the receiver from the hook



INDICATING DEVICE TELLS WHICH TELEPHONE LINE IS CALLING

opens the magnet (*B*) circuit and allows the armature to return to neutral position.

The entire outfit is inclosed in a case with only the indicating device exposed. Trouble caused by weak construction of the annunciator drops and careless operation was in that way effectively eliminated.

Parlin, N. J. J. W. TRUESDELL.

MIXED TRANSFORMER POLARITY BLOWS HIGH-TENSION FUSE

Although Practically All Transformers of Southwestern Utility Are of Additive Polarity, Polarity Is Always Checked When Trouble Occurs

While extended discussion is taking place between manufacturers concerning standardization of transformer polarity, central stations must continue to check connections when banking transformers. On the lines of the Texas Power & Light Company nearly all of the transformers have additive polarity, but in case of trouble in a bank of single-phase transformers after they are connected the first thing that is done is to check the polarity. The blowing of the high-tension fuse, when the transformers were apparently connected correctly on one occasion was at first puzzling, especially when it was found they operated satisfactorily on open delta. A check later indicated that one transformer was of subtractive polarity.

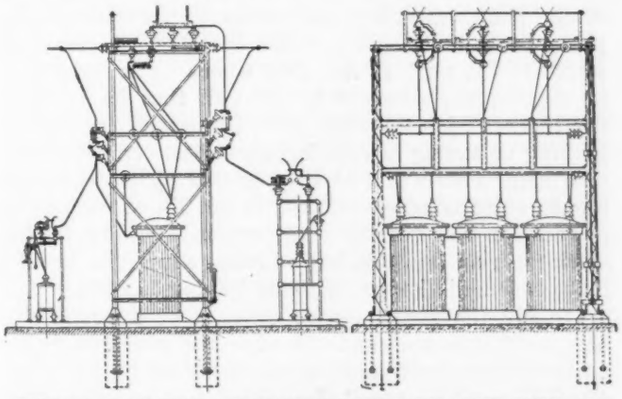
DISTRIBUTION OF COST IN OUTDOOR SUBSTATIONS

Seventy per Cent of Total Cost of 1200-Kva. Steel Tower Station Is Needed for Transformers Stepping Down 33,000 Volts to 13,200 Volts

Although the cost of outdoor substations varies with size, there is some relation between costs of the various materials and apparatus which go to make up the station. The outdoor substation shown herewith is a typical unit-type station so that the distribution of costs given in chart will be applicable to similar designs. It is used on a 33,000-volt transmission system and supplies a 13,200-volt line about 7 miles (11.2 km.) in length, at the end of which is the entire load.

The bill of material of this station gives the type of apparatus used as follows:

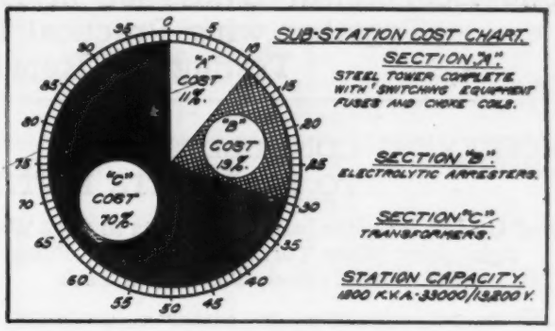
Section A of chart, representing 11 per cent of total cost, covers: One 200-amp., three-pole, 33,000-volt double-break-per-phase switch; three 33,000-volt, 200-amp. long-turn choke coils; three 33,000-volt fuse mountings with



TYPICAL UNIT-TYPE SUBSTATION WHOSE RELATIVE COSTS ARE REPRESENTED IN CHART

100-amp. carbon-tetrachloride fuses; one interlocked operating mechanism for the three-pole switch; three 33,000-volt, 300-amp., single-pole combination disconnecting switches with fuse mountings equipped with 15-amp. carbon-tetrachloride fuses for the 33,000-volt arrester circuit; three 13,200-volt, 300-amp., single-pole combination disconnecting switches with fuse mountings equipped with 20-amp. carbon-tetrachloride fuses for the 13,200-volt arrester circuit, and one expanded steel tower with bolts, nuts and clips for mounting equipment as shown in illustration.

Section B of chart, representing 19 per cent of total cost, covers: One three-phase, 33,000-volt electrolytic lightning arrester and one 13,200-volt arrester of the same type.



TRANSFORMERS REPRESENT NEARLY THREE-QUARTERS OF TOTAL SUBSTATION COST

Section C of chart, representing 70 per cent of total cost, covers: Three single-phase, 25-cycle, 400-kva., 33,000-13,200-volt outdoor transformers.

The above information was contributed by H. W. Young, president of the Delta-Star Electric Company.

FREQUENT CAUSES OF OIL-SWITCH TROUBLES

Why Switches Fail to Open or Complete Their Stroke, or Continue to Open and Close After Being Operated

Station operators of the Pennsylvania Water Power Company have been given a very complete set of instructions which indicate the procedure in operating and maintaining the hydraulic and electrical equipment under normal and abnormal conditions. These instructions, which were compiled by F. A. Allner, general superintendent, and Alex Bauhan, superintendent of stations, refer principally to conditions which have been found to require certain treatment. Some of the instructions follow, and more will be printed in future issues:

Whenever an oil switch has opened up on a short circuit, it is to be given a hasty inspection to determine what damage has been done to it. Ordinarily an oil switch may be returned to service after having opened under a heavy short, even if considerable oil has been spilled.

Numerous troubles may occur to oil switches from loose nuts, bolts, contacts, springs, friction, etc. If a switch fails to open it may be due to an open circuit in the control wire, a blown fuse, friction holding trip coil too tight, benchboard control button failing to make contact, or worm-gear thrust bearing being out of place, thereby jamming the worm and gear.

If a switch does not complete its stroke—that is, does not compress its springs for another operation—it may be due to an open circuit in the motor or in the magnetic clutch circuit, a bent master finger, opening motor circuit too soon, a blown fuse on motor circuit, or the magnetic clutch slipping, due to oil.

If an oil switch "pumps"—that is, continues to open and close after having once been operated—it may be due to a short circuit between the opening and closing wire, the tripping toggle not being properly locked after each operation, due to too fine an adjustment, or broken springs or parts of the mechanism. The quickest way to stop an oil switch from pumping is to open the control supply switch which feeds the particular group of switches where the trouble lies.

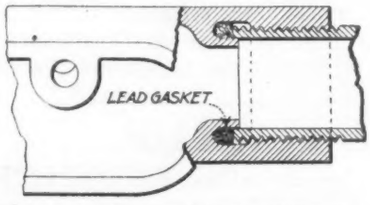
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

MODIFYING CONDULETS TO FACILITATE FITTING

Lead Gasket Provides Inside Condulets to Give Water-tight Joint When Turned Into Place—Filing Off Conduit Ends Too Slow a Task

When malleable-iron or cast-iron condulets are screwed on to conduits they will often split or a thread will be stripped in, forcing them into the desired position. On the other hand, if they are not screwed up tight the joint will not be waterproof. Of course this



LEAD GASKET IN FITTING OBVIATES SPLITTING AND GIVES WATER-TIGHT JOINT

difficulty can be overcome by filing off the end of the conduit, but this operation takes too much time.

The foregoing difficulties can be overcome by modifying all the condulets so that they will receive a lead gasket which will bear against the end of the conduit but will compress when necessary. Other compressible substances can also be used. The inclusion of such a modification in manufactured fittings would help considerably.

J. G. KOPPEL.

Sault Ste. Marie, Mich.

TROUBLES IN ELECTRIC WELDING OPERATIONS

The Spot Welder Which Throws the Most Sparks Is Not Necessarily the Machine Which Is Doing the Best Work

Successful spot-welding in commerical practice is largely dependent upon the quality of the steel to be welded. Rusty, scaly or dirty steel is difficult to weld on account of the tendency of the steel to burn at the surface before heating up uniformly to the welding temperature. When a well-finished, pickled and oiled steel is used good welding is very easy to achieve, and the saving in labor and rejected pieces results in increased production which will more than offset the increase in cost of good steel over the burned grades.

Since the process of welding is a combination of heating and pressure, it is necessary not only to regulate the amount of heat by means of the voltage but also to vary the pressure for this class of work. The average welder operator makes the mistake of using too high a temperature and insufficient pressure, and while this method gives a quick weld and enables the operator to turn out the maximum amount of work, especially when working on a piece-work rate, it usually results in poor welds because of the burning of the steel. Whenever a welder is throwing sparks it is a clear indication that too much voltage and insufficient pressure are being used and that the welds will probably be poor. This can always be corrected by decreasing the voltage and increasing the pressure. Most operators have the erroneous idea that in order to make good welds they must make the "fire fly"; on the other hand, the best welding is done when steel is not quite up to the sparking temperature with the application of sufficient pressure to bring the parts to be welded into intimate contact. Furthermore, from the standpoint of power consumption it is desirable to use as low a voltage as possible and to make the weld in a reasonable length of time.

This information was brought out by H. B. Craft, General Fireproofing Company, Youngstown, Ohio, and C. I. Crippen, Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, before a meeting of the commercial men of the Ohio Electric Light Association.

AUDIBLE ELECTRIC SIGNALS IN INDUSTRIAL PLANTS

Pressing Demand for Higher Efficiency in Production Has Led to Wide Introduction of Audible Signals

Audible signals installed in proper places throughout an industrial plant serve a variety of useful purposes. A needed person, no matter where he may be in the plant, hears his call, comes to the nearest telephone booth and reports to the operator. A craneman comes to the part of the aisle where he is needed, or he notifies the foreman by his call that he is ready for the next job. Special calls are issued for the beginning or ending of certain operations. In the middle of a noisy textile mill or shipbuilding plant, where the human voice is hopelessly lost in the din of machinery, a workman can get the necessary instructions for his work from an invisible but insistent source, or he may make his needs known without leaving his place.

Usually the signal device consists of a round diaphragm fastened around the edge and provided in the center with a small anvil which is struck by a toothed wheel driven by a small electric motor. In some other devices the diaphragm is made to vibrate by means of an alternating-current electromagnet.

An early objection to the introduction of audible signals in industrial establishments was due to the fact that the motors of these devices used to be wound for low voltages, necessitating separate storage batteries of 6 volts to 12 volts. Of late years electric horns have been developed with motors wound for 110 volts or 220

volts, alternating current or direct current, so that they can be connected directly to the power circuit. The operating switch may be either connected directly to the same circuit, or it may be on a local bell wiring, closing the motor circuit through a relay.

Ithaca, N. Y. V. KARAPETOFF.

ELECTRICITY ECONOMICAL FOR JAPANNING AND ENAMELING

Because of Smaller Output and Larger Rejections from Gas Ovens, Electricity Is Considered 20 per Cent Cheaper than Gas

To determine the relative advantages of gas and electricity for japanning and enameling automobile parts, the Chandler Motor Car Company conducted tests on a double gas oven and a double electric oven, the input of energy to each being measured carefully. In one week's time parts for 498 cars were enameled in the electric ovens at an average cost of 28 cents per car for heat, and the rejections were only 3 per cent. With the gas ovens, however, parts for only 210 cars were turned out, at an average cost of 23 cents per car, and the rejections were about 18 per cent.

Considering the greater amount of work and the better quality turned out by the electric ovens, Charles E. Lohr, assistant production manager, considers that electricity is about 20 per cent cheaper than gas. At that time gas cost about 30 cents per 1000 cu.ft., but it is now 35 cents and is likely to go higher. Electricity was secured at 9 mills per kilowatt-hour.

ALARMING TEST READINGS TURNED OUT HARMLESS

Potential Between Conductors and Core or Frame or Between Insulated Conductors When Energized Not Always Sign of Insulation Fault

The two phase windings of quarter-phase motors are generally insulated from each other, and ordinarily one might not expect to get a deflection on touching one terminal of an alternating-current voltmeter to a conductor of one of the phases, the motor being in operation, and the other terminal of the voltmeter to a conductor of the other phase. However, a considerable deflection will be obtained because of the capacity included between the phases. Similarly, if the voltmeter terminals be applied to any one of the phase conductors of a three-phase machine and to the frame of the machine, a considerable deflection will be obtained, although the frame necessarily is well insulated from all phase conductors. This, however, does not hold good in the case of a grounded neutral, which is another proposition and one not calling for consideration in the present article.

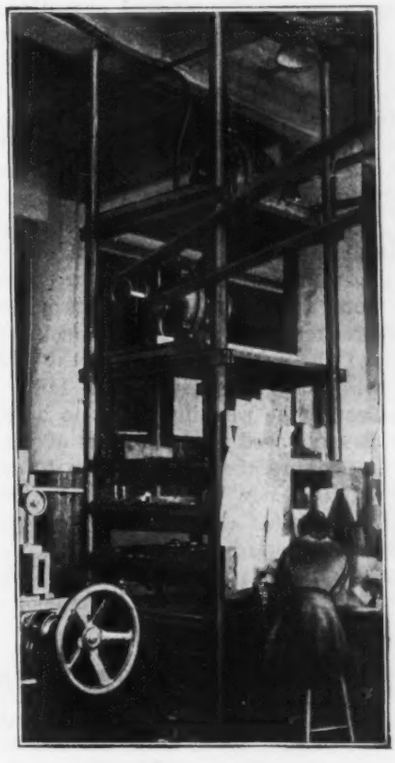
It is not at all surprising that such a deflection should obtain, but it was surprising in a certain instance to find that the value of the capacity deflection increased and decreased with the value of the load of the motor. The experience had to do with the measuring of the output of a 40-hp., 440-volt, three-phase motor that was used for driving a Jordan grinder the duty of which was to shred cotton. The operator had noticed that a deflection could be obtained by touching the voltmeter to a phase conductor and to ground, and he had become alarmed about it because he thought that the insulation of the motor was failing. On taking the capacity deflection with two voltmeters the rise and fall of the deflection with the motor load was found to be about the same on all of the phases. With the motor operating at about half load the deflection was about 75 volts, but when cotton stock got jammed in the grinder, sending the motor to about 400 per cent of full rated load, the deflection would increase to more than 300 volts. Measuring of the insulation after the test showed the insulation resistance to be several megohms.

Brooklyn, N. Y. E. C. PARHAM.

UTILIZING THE SPACE UNDER MOTOR SUPPORT

Installation That Might Have Wasted Space Made Effective by Placing Two Motors on Standard and Using Other Space for Shelves

Having to install a motor for driving a line shaft in the middle of a floor in order to furnish the desired drive, one industrial plant made the best of what might have proved an inefficient mounting by fully utilizing the space occupied by the supports. The mounting consisted of four verical 2.5-in. (6.3-cm.) pipes embedded in the concrete floor and fastened to the ceiling. Attached to these were angle irons on which the motor platform was laid. It so happened that another motor was needed near the same position, so the space directly below the first motor was used for the support of the second. The remainder of the space was utilized for trays in which were kept various tools used by the operators of machines in the vicinity, who were thereby saved much time by not having to make trips to the tool room for needed implements.

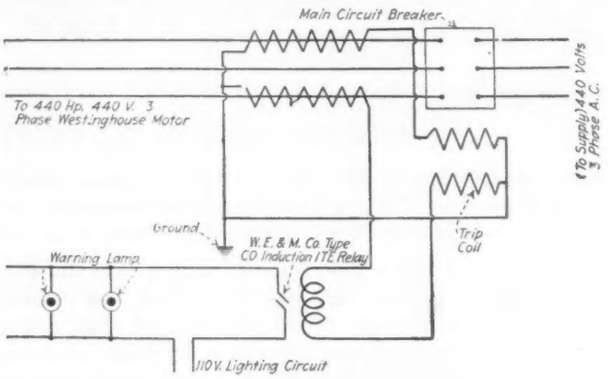


TWO MOTORS AND TOOL TRAYS UTILIZE FULL SPACE TAKEN BY SUPPORTING STANDARD

HEAVY OVERLOAD INDICATED BEFORE CIRCUIT BREAKER OPENS

Signaling System Notifies Operators When It Is Not Best to Feed Raw Material to Rubber Machines, Thus Preventing Circuit Breaker Opening

Frequent opening of circuit breakers and consequent delay are sometimes encountered in rubber mills when several machines are driven by one motor, even if it is


Main Circuit Breaker
To 440 Hp. 440 V. 3 Phase Westinghouse Motor
To Supply 440 Volts 3 Phase A.C.
Ground
W.E. & M. Co Type CO Induction ITE Relay
Trip Coil
Warning Lamp
110 V. Lighting Circuit

RELAY IN TRI-COIL CIRCUIT ENERGIZES LAMPS BEFORE LOAD OPENS CIRCUIT BREAKER

of sufficient capacity for normal operations. This is especially true in connection with the mixers on account of the instantaneous overload duty exacted from the motor when several operators working on machines driven from the same shaft place pieces of crude rubber in the machine at the same time. In order to eliminate this trouble, engineers of Lockwood, Greene & Company designed a signaling system that warns the operators when they should not add raw material to the machine. It consists essentially of one relay and a red lamp placed in front of each of the eight machines. When the motor current reaches a certain percentage of the circuit-breaker opening current (amount determined by operation) the relay, which is of the Westinghouse CO type, will close the switch of a 110-volt lighting circuit and cause the warning lamps to be lighted.

The lamps are placed near the level of the operator's eyes, and it is therefore easy for him to see when he can safely put in a new batch of rubber. Vapor-proof fittings with the glass cover omitted are used for the lamps, but a wire guard prevents breakage.

New York, N. Y. H. A. DODGE.

INDUCTION MOTOR AS A SYNCHRONOUS MACHINE

Low-Speed Induction Motor Has Better Characteristics When Operated as Constant-Excited Synchronous Motor

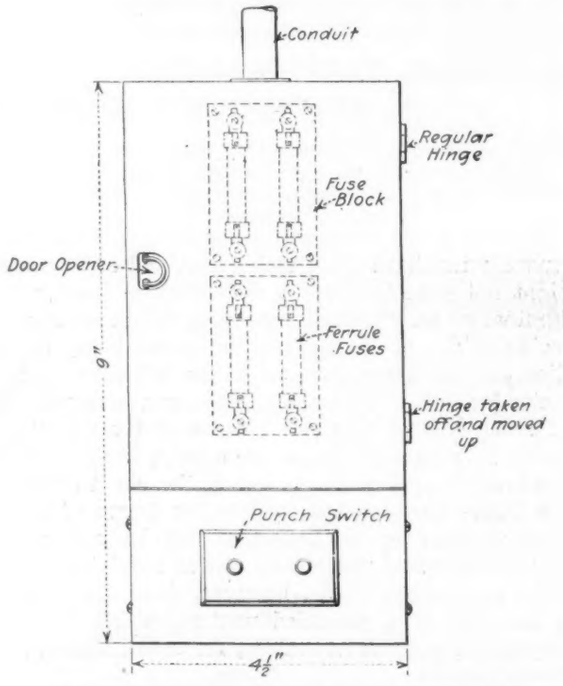
Since the power factor of low-speed, large-capacity induction motors is low at the best and drops off rapidly with decrease in load, some industrial plants may find it advantageous to operate them as synchronous machines if they are of the wound-rotor type. This can be done by connecting one side of a direct-current supply to one slip ring and providing means whereby the other side can be connected to the other two slip rings after the machine has been brought up to synchronous speed as an induction motor. Of course such operation will not be satisfactory unless the motor operating as an induction machine has high magnetizing current, has a low rotor resistance and is not loaded too heavily when the conversion to synchronous operation is made. The best exciting current to use can be determined by conducting a power-factor test, care being taken not to allow the field current to exceed the slip-ring current when the motor is running as induction motor.

Operating as a synchronous machine, the speed will, of course, be constant regardless of load and the rating will be increased compared with that when operating as an induction motor. Furthermore, the power factor and efficiency will be considerably improved. It should be understood that the characteristics will under no conditions be so good as those of a motor primarily designed for synchronous operation and that the suggested method is merely an expedient.

REMOTE-CONTROL RECEPTACLE IS MADE FROM CUT-OUT BOX

Cover Is Sawed in Two Parts and Hinge Moved Up — Makes a Neat-Appearing Receptacle Which Can Be Mounted Close to Machine Operator

Needing a receptacle for a remote-control push-button switch on short notice, the electrical department of an industrial plant in New Jersey made a neat-looking device from an ordinary 4.5-in. by 9-in. (11-cm. by 22-cm.) cut-out box. About 3 in. (8 cm.) of the lower half of the lid of the box was sawed off and permanently



NO EXTRA PARTS NEEDED TO CONVERT THIS BOX

fastened to the box by means of screws—after a hole had been punched out and a push switch placed in position. The hinge formerly attached to this piece was removed and placed on the part having the other hinge. This gave a swinging door which could be opened by the original ring attached to it. In the open space two fuse blocks are mounted and are thus easily accessible.

IRVING E. SWEAZEY.

Plainfield, N. J.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

DISCUSSION ON POWER FACTOR BY ALEX DOW

Conditions Affecting Application of Clause in Rate Schedules—Not Yet Within Reach Except in Experimental Form

In connection with the presentation of the report of the rate research committee by the chairman, Alex Dow, president Detroit Edison Company, at the recent Atlantic City convention of the National Electric Light Association, there was a discussion on the power-factor clause. In his remarks on this subject Mr. Dow said:

Another clause which had a considerable vogue during the war period was the power-factor clause. Now, everybody with a power-factor clause says it is all right, but I sometimes think that the professions which reach me, that it is absolutely all right, are like those of the fellow who married the wrong girl and would not acknowledge it. It is troublesome to enforce a power-factor clause, especially a graduated power-factor clause. While the committee has recommended the use of it where possible, and pointed out the equity of it, the methods of application of the charge, whether it be a charge for additional cost of service due to bad power factor, or whether it be a penalty intended to be a deterrent, in each case necessitate an adjustment of costs which must be worked out.

Power-Factor Clause Not Yet Within Reach

The safe thing to say about the power-factor clause is that it is something that is not yet within our reach in such form that we can consider it as anything but an experiment.

It is perfectly feasible with an educated customer who has either electrical knowledge or good technical advice, and who is a reasonable person, to get along very nicely with a power-factor clause. It is still more easily possible to persuade such a customer in his own interest to keep a better power factor, pointing out to him that he is neglecting his own interests as well as impairing service to his neighbors by maintaining a poor power factor, and if the methods of correction are simple, and clearly advantageous to him, you can do something with him.

But, remembering that we serve the general public, and remembering that the users of alternating-current motors are legion, remembering that every man buys the motor "a little bit big" so that he will have power when he needs it, I do not know what you can do to better a general power factor by any rate method. The mere determination of the power factor, for the purpose of making an adjustment monthly or annually with each medium-size customer, is an expense, combined with the possibility of argument, which I certainly could not recommend any member company to undertake lightly.

Power factor in a street-railway contract and in a large industrial contract is a matter of education, of method and of mutual understanding or mutual helpfulness. Power factor with the man who puts in 100 hp. or 150 hp. or 300 hp. of induction motors, and who runs at 50 to 75 per cent power factor, is something he does not know about and does not much care to know about.

A number of questions were then asked by delegates. Mr. Dow said in answering them that they did not belong in the field of the committee and that the answers must be considered as by him personally. He added:

Every man making motors, and every salesman selling motors, and every curbstone contractor who scalps a commission on a motor when he has a friend who wants a little wiring done, wants to sell the biggest motor so as to get the biggest commission. The great power-factor difficulty is due to many small motors with power too great for their work. If you convince a man that he can buy a motor big enough to-day which will be a safe motor, and later trade it in for the larger motor which he expects and hopes he will soon need, you will be able to do a great deal. But your greatest trouble is the man who proposes to get his commission on the biggest motor he can sell. We all frequently give our commission accounts the benefit of the doubt.

The trouble with low power factor is that it is not due to your big customers, such as electric furnaces and welders. The thing that makes trouble is the multiplicity of the average motor user. It is like the London smoke. London smoke is the result of the everlasting little single household grate. That is what makes the smudge there. Now, in our case the grief is the small motor, and if you cannot tell the man that he can save money now, and then when he needs more power he can make a trade quickly, the case is hopeless. On the other hand, if you can make a ready exchange, at small loss to yourself, you will do much good unquestionably.

As to power-factor-correction devices, you can do much to encourage the use of power-factor correction by the synchronous motor. Now, right here let me say, for the benefit of the proper committee, that the small synchronous motor is not an impossible proposition, and its costliness is now so great in proportion to the induction motor because it is not manufactured in quantities. You go after a synchronous motor of 100 hp. and upward, and you find it is something special, and the customer you want to buy it will not wait for something special.

I do not know why the production of synchronous motors in commercial sizes—I would not say as low as 50 hp., but say 75 hp. and up—should not be standard; and why the synchronous motor with the direct-connected exciter should not be marketed at a price to make it acceptable; but when the difference is 30 to 35 per cent, you come up against obstacles. The customer says, "I want service; I do not know anything about power factor, and I do not want to know." You can convince the larger customer where the increase is 30 or 40 or 50 per cent in transformer or wiring capacity, if his power factor is bad—you can convince him, but you cannot convince the 50-hp., 75-hp. or 150-hp. man that he should pay 30 per cent more on that which does not make a direct return to him on the investment.

Static Condensers Considered

If static condensers come into use and prove to have commercial value, that will be of some help. But most companies must recognize that the public is better and more cheaply served by induction motors whose power factor will be somewhere about 75 per cent than by the more efficient, and that the problem resolves itself into the equitable division of the cost between the company and the customer. You will end by proving to the customer that it is worth his while to change it, or he will not make the change; or else you will apply enough correction at your expense to balance the cost, and nothing more.

Another question was asked, whether penalty for low power factor should be equalized by bonus for high power factor. What difference does it make? If you want leading current supplied to your system to cancel lagging

current, you should pay for the leading current. It is theoretically immaterial whether you pay for it by a bonus proportional to the angle of lead or whether you hire the customer to run his synchronous apparatus with over-excitation, but the latter is likely to be the simpler way.

But let me make again the point I made in my first talk, which is that you must distinguish between the two ideas as to rates intended to correct low power factor. One idea is that low power factor merely adds to the cost of the service, and therefore the increased cost of the service should enter into the rate as part of the total cost, before you begin to get your reasonable profit on the service. The larger idea is that poor power factor—needlessly, sloppily poor power factor—is a nuisance and ought to be penalized as such. The inherent difficulty with this large idea is that we all want the growth of our business which is anticipated to arise from the use of the smaller electrical furnaces in metal working and other applications of electric arcs whereof the power factor is essentially low.

You have, when inviting the use of such devices on your circuits, to deal not only with the man who wants to sell to your customers a device having a needlessly bad power factor, but you have also to deal with the man who wants to sell devices which needlessly give you all sorts of unbalanced loads. You must face the fact that your public wants to be served and must be served, and you must distinguish in your rulings as to acceptable devices, and as to the use of these devices, between conditions which injure service to other customers and therefore should be specially penalized and conditions which, if they be given too much importance, will compel your customer to purchase regulating and balancing apparatus which will needlessly increase his cost of running.

You will have to say, in so many words, that apparatus which has a power factor below a certain value will not be tolerated on your circuits unless the disturbance which it causes is simultaneously corrected at the expense of the customer. It is right that the customer desiring to use a public service should pay for the correction of intolerable conditions introduced by him. But you simultaneously have to acknowledge that low power factor is an inherent characteristic of electric power service by alternating currents, and that the correcting of the system conditions resulting from the use of devices which can reasonably be tolerated is part of the total cost of the service.

A Penalty or a Bonus?

Now as to whether you should put a penalty on very low load factor or pay a bonus for reasonably good load factor, let me ask, why should we pay a man for being ordinarily good? If you penalize him for a power factor lower than, say, 70 per cent, you are thereby interfering with his freedom in order to protect the common good and your action is equitable. Between the man who should be penalized because he is spoiling service to his neighbor, and the other extreme where the man so operates his plant as to help his neighbors, there is such a wide zone of reasonable or normal alternating-current practice that the penalty imposed upon the trouble-maker may be contrasted with or counterbalanced by compensation given to the remover of the trouble. The equities applicable to the two extremes are obvious. But in the intervening normal zone I should hate to have to settle with each customer according to his mean or average power factor during the settlement period.

Answering the inquiry as to meters, I would say that the Sheffield (England) municipal plant, which has had tremendous development during the war and which has served a logical as well as a national necessity, was possibly able to do things summarily which in time of peace it could not have done with less than fifteen letters to the *Times* and two acts of Parliament. It has used recently a Hopkinson form of rate for energy supplied for mixed loads, including steel furnaces, in which the first charge is a fixed charge per kilowatt of demand, followed by a meter rate per kilovolt-ampere-hour. There is good argument for doing it the other way around—making a fixed charge per kilovolt-ampere of demand and a meter charge per kilowatt-hour. And, again, water-power practice and steam-power practice may find it desirable to differentiate. But without going into any complexities I suggest that what we might call the Sheffield idea might well be applied to the tremendously large portion of the power supplied in the United States by our member companies which is now served under the Hopkinson form of two-part rate. . . .

Solving the Meter Problem

Therefore let me say, once more passing the buck and standing from under, that the rate research committee two or maybe three years ago pointed out that if utility commissions, guided by technical officers or possibly by the United States Bureau of Standards, would consent to approve a meter of the ordinary form which was lagged in such a way that it did not read correctly kilowatt-hours but did run at an increased speed as power factor went down, we could without the application of any new meter principle, and without promoting too much patent litigation, obtain from at least three makers a meter looking exactly like our present meters and having no new elements, which meter would penalize or correct the charges for service proportionately as the power factor fell off and in any degree that was desired. You know how it is with any of the ordinary meters, that they can be made to speed either proportionately or inversely as to power factor or some function of the power factor. The metering device, therefore, is ready at hand, and it seems only to need, as a preliminary to its use, the approval of some forty-eight separate state authorities, a few bureaus at Washington and a trade name.

OFFICE SYSTEM ASSISTS SERVICE TO CUSTOMERS

Forehanded Methods of Arranging Records and Routine Make It Easy to Do Business with Central Station

Service to the customer of the Columbus (Ohio) Railway, Power & Light Company begins even before he comes in to make his contract. Dodge building reports are received by the central station, and the company later sends out a man to make an investigation on each new house, from which a record of the location, builder, size of house, etc., is made. This is filed in what is termed the "preliminary file," which consists of a system of 6-in. by 9-in. envelopes open at one end and made without a flap, into which all matter concerning a particular house goes. These are filed according to street and number.

When the customer ultimately comes in to sign a contract the company brings this envelope from the file and is able to tell the customer things about his own house that he did not know himself in some instances. With the signing of the contract the envelope is transferred from the preliminary file to the customers' file, where it is again placed according to street and number, and thereafter it contains a record of all transactions between the company and the resident at that address. All printed forms used are 5½ in. by 8½ in. (14 cm. by 22 cm.)—one-half letter size—or smaller, so that they are contained in the envelope without any necessity for folding.

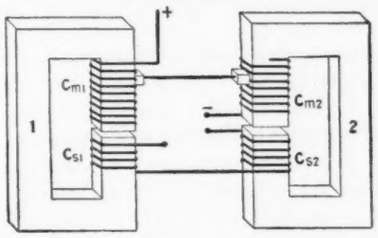
If a customer coming in to sign a contract is living in a house previously occupied, the envelope for this address in the permanent file is consulted, and from the data therein shown he can be told whether he will have service "to-day or to-morrow." In addition, the information is there from which to make out the work order for connecting the new customer.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Transformation of Direct Current to Alternating Current.—O. LI GOTTI.—The problem of transforming direct current to alternating current and vice versa without the use of commutators, valves or interrupters was solved thirteen years ago by L. Magrini. A new solution of the problem is now given, and from it is developed a novel form of direct-current motor without a commutator. The principle on which the devices act is the generation of electromotive force in a closed winding by causing the coefficient of self-induction to vary. One method of effecting this is illustrated in the figure, in which two magnetic circuits are shown, each having a primary winding C_{m_1} and C_{m_2}, connected in series to the direct-current mains, and secondary windings C_{s_1} and S_{s_2}, connected in series as shown. The brushes shown on the two primary windings move downward and upward together, thus increasing and decreasing the fluxes in the two circuits respectively. The result is to produce electromotive forces in the two secondary circuits that add, so that these secondary circuits become the seat of an alternating electromotive force of a frequency depending on the period of the up-and-down motion of the brushes. The apparatus can be reversed so as to convert alternating current into continuous current, the secondary winding being connected to a direct-current source to provide the magnetization of the cores. The use of brushes rubbing on contacts may be avoided in the above-mentioned devices in two ways: (1) By winding the wire backward and forward off one primary on to the other, or (2) by varying the reluctance of the two circuits by moving an armature consisting of solid magnetic masses so that the reluctance of one circuit is increased when that of the other is decreased, and vice versa. Several designs of direct-current motors are developed from the ideas underlying the above devices. An armature containing a winding revolves between a series of pairs of poles (north poles on one side and south poles on the other) and the winding has a pitch equal to that of two poles. Direct current is sent through the armature winding, and the strengths of the successive poles are unequal and vary according to the position of the armature. This variation of the strengths of the poles may be effected either by brushes rubbing on the exciting windings and rotating with the armature or by magnetic masses moving with the armature. By suitable choice of the conditions continuous motion of the armature may be produced, so that it acts as a continuous-current motor.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Revue Générale de l'Electricité*, March 29, 1919.)



GENERATION OF ELECTROMOTIVE FORCE IN A CLOSED WINDING CAUSES COEFFICIENT OF SELF-INDUCTION TO VARY

Lamps and Lighting

Notes on Railway Lighting and Its Maintenance.—A. CUNNINGTON.—The writer presents a curve showing the remarkable increase in illumination of railway cars in the last twenty-five or thirty years. The measurements show illumination in the middle of a compartment at the ordinary level of a book or newspaper under lamps with colza oil, gas burners, gas burner with mantle or electric filament lamp. These are roughly associated with the periods 1890, 1900 and 1910 respectively. The rapid rise of the curve may be taken as typical of the general tendency in standards of illumination.—London *Illuminating Engineer*, March, 1919.

Generation, Transmission and Distribution

Low-Voltage Direct-Current Electromagnets and Solenoids.—HENRY W. TOWNSEND.—Data on the construction of direct-current-action as well as solenoid types of magnets for use on battery circuits are given for magnets and solenoids which have been built and tested.—*Power*, May 27, 1919.

A Modern Substation.—ROY R. KIME.—Design features of the Forty-fifth Street substation of the United Electric Light & Power Company in New York City are taken up. The substation is installed in a building with narrow front and walled in by other buildings, as is typical of Manhattan building sites. The substation has limited floor space at street level and extends upward for several stories. The capacity is 10 kw. per cubic foot, which is said to be about double the usual concentration.—*Power Plant Engineering*, May 15, 1919.

Power System of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company.—GRAHAM BRIGHT.—The load of the Philadelphia Electric Company is somewhat greater during the winter months than during the summer, so that this company has a surplus capacity during the summer months. The South Philadelphia works, on the other hand, are steam-heated, requiring steam at pressures from 2 lb. to 4 lb. This steam can be produced most economically by generating it at high pressure and passing it through non-condensing turbines operating at a back pressure of from 2 lb. to 4 lb. It was therefore decided to install non-condensing turbines and generate all power required during the winter months. The power plant is located at the works. When steam is not required for

heating purposes power is purchased from the Philadelphia Electric Company. Details of the substation and distribution system are given in this paper. It may be of interest to note that control wires are carried from the power plant to the outdoor substation by the underground system and that the outdoor substation can be operated from the power-plant switchboard.—*Electric Journal*, April, 1919.

Light-Weight Electric Generating Sets.—A light-weight generating set composed of gasoline engine and electric generator for use close to the front-line trenches was designed for military purposes. British designs are described and illustrated in this article. As typical of the results mention may be made of a generating unit of 2-kw. output with over-all dimensions of 2 ft. 6½ in. (77 cm.) long, 1 ft. 10 in. (56 cm.) wide and 2 ft. 5¼ in. (74 cm.) high. The weight inclusive of the switchboard is 175 lb. (79.4 kg.). The efficiency of the generator is 82 per cent, with a petrol consumption at full load of about 0.44 gal. (1.66 l.) per hour.—London *Engineering*, April 25, 1919.

Russian Water-Power Possibilities at Dnieper-River Rapids.—V. V. TCHIKOFF.—The total potential water power of European Russia alone is estimated at 20,000,000 hp. or more. The rapids of the Dnieper River present one of the more interesting possibilities for early utilization. These rapids constitute one of the greatest obstacles to navigation on the canal system connecting the Baltic and the Black Seas. The development of the Dnieper River rapids to the extent of some 600,000 hp. is planned at a cost of some $60,000,000. A table giving the estimated cost of construction and operation of these plants is appended to the article.—*Engineering News-Record*, May 29, 1919.

Traction

Main-Line Electrification.—In connection with the proposal for general electrification of the British railways system it has been proposed to run extensive transmission systems along the railway right-of-way. In this article the problem of providing for an adequate transmission system over the right-of-way is discussed, and it is pointed out that the space limitations make the use of extensive overhead structures difficult, if not out of the question, especially in passing through cities. The other alternative of putting high-tension cables under ground is discussed, but this is shown to be a very expensive proposition.—London *Times Engineering Supplement*, April, 1919.

Installations, Systems and Appliances

Electrical Application of the Schoop Process.—W. KASPEROWITZ.—A description is given of the method of heating the metal to be squirted by means of the electric arc. Besides this method, in which two wires of the metal are fed to form the two electrodes of the arc, it is also possible to use a single-wire electrode, although this arrangement is subject to considerable technical difficulties. It is to be hoped that the single-wire process may be capable of development for use with the more easily fusible metals and alloys. The Schoop process may be used for forming the plates of condensers by depositing metal on glass. Also good electrical contacts may be produced by squirting metal onto the metal surfaces to be electrically connected. Carbon electrodes may be joined to metal terminals by the use of the squirting pistol. This has important application in the manufacture of electric furnaces for carbide and other substances and in the construction of carbon brushes for dynamos. Brushes may also be made of metal deposited on paper of another such support. The Schoop process is suitable for replacing soldering or brazing, for instance, in the construction of squirrel-cage armatures with aluminum bars, which are first coppered and then soldered. The joints of steel rails of electric railways may be connected by a deposit of zinc, thus eliminating copper bonds. Insulators may be coated with metal so as to improve in certain places the distribution of the electric field and so avoid local high intensities. It has even been proposed to make light accumulator plates by coating asbestos, fiber or other light materials with a layer of lead. Electric heaters are produced by squirting metal on the fireproof slabs.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Elektrot. Zeits.*, Jan. 16, 1919.)

Electric Furnaces in the United Kingdom in 1918.—R. G. MERCER.—The author states that there are installed in the United Kingdom 141 electric furnaces with a total capacity of 112,000 kva. Of these twenty-four are or will be used for Swedish substitute, cupro nickel, allundum, manganese, copper and ferro alloys. The remaining 117 are electric steel furnaces, having a total charging and kva. capacity of 384 tons and 98,789 kva. respectively and a total nominal output of 31,170 tons per month, based on five days a week, four weeks per month. Assuming that these furnaces are working at full load, the total output for a year would be 405,000 tons. The 117 furnaces now in operation are made up as follows: Heroult, 45; Electro-Metals, 27; Greaves-Etchells, 26; Snyder, 6; Stobie, 5; Rennerfelt, 4; Stassano, 2, and special, 2. The following table is offered by the author as typical of British electric furnace practice:

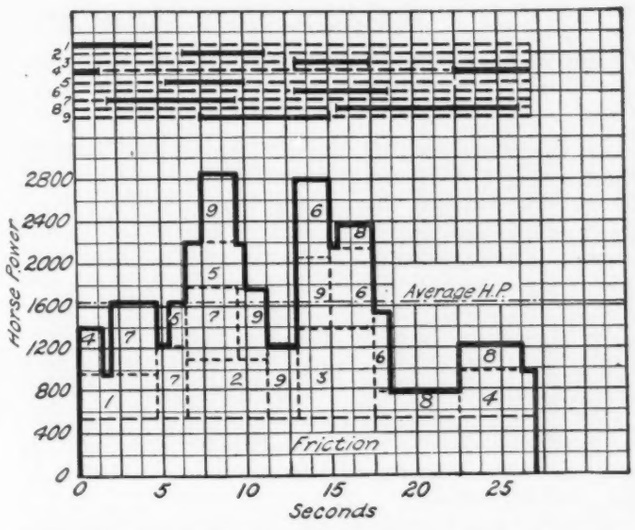
Ingots or Castings	Size, Tons	Kva.	Average Hours per Heat	Number of Heats per Day	Nominal Tons per Month 20 Days
Ingots	¼	250	2.75	7	70
Castings	¼	250	2.25	8	80
Ingots	1½	500	3.25	6	180
Castings	1½	500	3.00	7	200
Ingots	2 2½	650	4.25	5	240
Castings	2 2½	650	3.5	5	240
Ingots	3 3½	850	5.75	4	280
Castings	3 3½	850	4.75	4	280
Castings	5	1,000	4.00	5	500
Ingots	6	1,500	7.5	3	360
Ingots	7	1,800	7.5	3	420
Ingots	10	2,500	7.5	3	600
Ingots	15	3,000	7.5	3	900

—London *Electrical Times*, May 8, 1919.

Application of X-Rays to Testing Materials.—The application of X-rays to determine the nature of crystalline structure is most important from the scientific standpoint and as yet has hardly passed the experimental stage, but their use for the detection of flaws and blowholes in masses of steel and iron seems to be already a practical fact of immediate commercial value. Instances of the use of X-rays in this way were given in the general discussion of the subject at a recent joint meeting of the Faraday Society and the Röntgen Society. It was shown that a needlessly high factor of safety and consequent waste of material have been incurred owing to mistrust of internal flaws in material. The method of examination of lead-sheathed cables and rubber appears to be a promising application of X-rays. —London *Electrician*, May 9, 1919.

Application of Synchronous Condensers to Large Power Systems.—G. V. ADENDORFF.—The discussion is confined to systems in which the capacity effects are negligible in comparison with the inductance effects and in which several power stations are interconnected and operated in parallel with a ring main scheme of distribution networks. The system is investigated particularly from the point of view of efficiency, with and without synchronous condenser. Charts are offered to make the calculation of size of synchronous condenser easily selected, and also to show how low the power factor must go, under given conditions, to make the synchronous condenser installation economical.—*Transactions South African Institute of Electrical Engineers,* March, 1919.

Electric Drive for Steel-Mill Main Rolls.—K. A. PAULY.—Steel-mill roll drives may briefly be divided into three classes, non-reversing single-speed mills, non-



REVERSING MILLS ARE SUBJECT TO HEAVY OVERLOADS FOR A SHORT TIME

reversing adjustable-speed mills, and reversing mills. The requirements of the single-speed mills are the simplest from the standpoint of the motor equipment; they may be driven by either direct-current shunt or compound motors, or by single-speed induction motors. For adjustable-speed mills two-speed slip-ring induction motors have been used to a limited extent, but where reasonable efficiencies are demanded the so-called Scherbius system has been found to give the most satisfactory results and the widest range of speed. The motors driving reversing mills are subjected to extremely severe usage. They are required to carry tremendous overloads at all speeds in either direction of rotation and must be capable of rapid acceleration. Direct-current motors are used for these mills, with the Ward Leonard system of speed control or a combination Ward Leonard and motor field control. The satisfactory operation of any of these installations is dependent upon the control apparatus, and the design and construction of this equipment demands equally careful consideration with the motors themselves, down to the minutest details.—*General Electric Review,* May, 1919.

Wires, Wiring and Conduits

Cable Lay-Outs for Works and Factories.—A. F. W. RICHARDS.—The author takes up problems encountered by engineers in designing cable lay-outs and in the installation of heavy cables in factories. His article is divided into two parts, the selection of cables and the installation of cables.—London *Electricity,* May 16, 1919.

Standard Specifications for Hard-Drawn Copper Wire.—This bulletin contains specifications drawn up by the American Society for Testing Materials in giving the standard physical and electrical tests for hard-drawn copper wire and trolley wires.—*U. S. Department of Commerce Industrial Standards No. 50,* 1919.

Measuring the Capacity of Three-Phase Armored Cables.—RAYMOND BUZON.—The author indicates a method by which to find by a single measurement the value of what he calls the "starred capacity" of a three-phase cable, which permits the calculation of the current of capacitance in the cable when functioning without load under its three-phase service voltage.—*Revue Générale de l'Electricité,* May 3, 1919.

Electrophysics and Magnetism

Piezo-Electricity and Its Applications.—It is said Piezo-electric crystals develop electric polarities when heated and that the phenomenon might be of use in studying the physical phenomena connected with explosion.—London *Engineering,* April 25, 1919.

Fatigue of Selenium Cells.—P. LENARD.—Until recently selenium cells were erratic in their behavior, showing variation in the dark resistance, a great dependence on previous treatment, considerable inertia and marked fatigue. The new cells now obtainable are much more reliable. The tests described were made with cells obtained from the Radiologie company, Berlin, and had the object of ascertaining under what conditions these cells would be suitable for the measurement of light intensity. Some of the cells assumed a constant resistance forty-five seconds after being exposed to light and were thus specially suited for the purpose in question. The test specimens were subjected to alternate periods of light and darkness. With increasing length of the dark periods the difference between the resistance at the successive light periods diminished, and at periods of eight minutes of darkness the resistance during the light periods became constant with an illumination of 47.4 lux. The length of the dark periods producing this constant resistance under successive light stimuli was found to vary with the intensity of the illumination. When the intervals are long several cells may be used in rotation to save time.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Electrot. Zeits.,* March 6, 1919.)

Electrochemistry and Batteries

Dry Cells.—French Patent No. 487,645 of A Heintz describes a form of dry cell that may be stored permanently without deterioration. The positive electrode of manganese dioxide and graphite is inclosed in a tube of zinc, forming the negative electrode. The zinc tube is closed at the ends by cardboard caps, and a hole is provided at one end to introduce the electrolyte just before the cell is put into service. The two electrodes are separated by a tube composed of paper boiled in a solution of carbonate of soda and then compressed. This tube is provided with a series of vertical slits.—*Technical Supplement to Review of Foreign Press,* April 29, 1919. (Abstracted from *Revue Générale de l'Electricité,* March 29, 1919.)

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

PRESIDENT ADAMS RETURNS FROM HIS TRIP TO EUROPE

Efforts on Behalf of Standardization Made by Him in Association with H. M. Hobart Promise Beneficial Results

Prof. Comfort A. Adams, president of the American Institute of Electrical Engineers, has returned from the trip which he made to England and France with H. M. Hobart of the General Electric Company in the interest of standardization. Professor Adams landed at Halifax, N. S., and reached his home at Cambridge, Mass., on June 15. He spent several days in New York at the close of last week before going to Lake Placid for the annual convention of the Institute. Mr. Hobart remained abroad and is doing important work of the same character as that in which he and Professor Adams were engaged. Mr. Hobart will probably return about the middle of July.

Professor Adams and Mr. Hobart crossed the Atlantic to adjust certain differences between the American and French rules with regard to the rating of electrical machinery which had arisen during the war, when a meeting of the International Electrotechnical Commission was not possible. As a result of the conferences held abroad an arrangement was made satisfactory to all concerned, and certain changes from the previous International Electrochemical Commission rules will therefore be recommended at the next regular meeting of that commission. This meeting will probably be held in London during the latter part of October in this year.

Another commission of Professor Adams and Mr. Hobart was on behalf of the American Engineering Standards Committee in order to establish relations with corresponding committees in other countries. In France the corresponding organization is called a Permanent Commission on Standardization and is appointed by the Minister of Commerce. In Holland the organization is known as the Normalization Bureau. In England it is the Enginering Standards Association and was organized originally by the five national engineering societies. It has government affiliations and regularly does the standardization work of the government in certain important fields. In Switzerland a similar organization is contemplated, but it has not yet been perfected. The organizations of Holland and France are of comparatively recent origin, as is the American Engineering Standards Committee. The British association has been in operation about eighteen years and is doing an enormous amount of very important work, having secured the confidence of the government and many organizations (including those in the railway and shipbuilding fields) not directly represented on the main committee. For example, the aircraft section alone of the Engineering Standards Association has about fifty sub-committees.

As a result of the conference held by the American delegates with the representatives of the organizations of other countries, very cordial relations were established with those associations. The resulting coöperation should prove of immense value to international commerce, as well as effect a reduction in cost of production in many fields.

RELATIONS WITH LABOR AN INDUSTRY PROBLEM

Arthur Williams, Who Presented Resolution at Atlantic City Convention for Committee to Consider This Subject, Gives His Views

At the Atlantic City convention of the National Electric Light Association a resolution was introduced by Arthur Williams, New York Edison Company, requesting the president to appoint a committee for the purpose of considering the subject of what is ethical and just in the relations of the industry and labor. In presenting this motion, Mr. Williams said that the industry had already been paced on record as in accord with the best modern thought on the question through the report prepared some years ago by a committee of which Charles L. Edgar was chairman. Mr. Williams urged in his brief discussion of the matter that, if possible, the services of Mr. Edgar should be secured as chairman of the new committee.

W. C. L. Eglin, who seconded the motion, suggested that the whole scope of the labor situation be studied, and particularly with the thought of suggesting that some profit-sharing methods be considered as applicable. The resolution was passed.

Mr. Williams was asked by a representative of the ELECTRICAL WORLD to state further what ideas he had in mind in presenting the matter. He said:

"The central-station industry has always been a leader in public movements. Its officials have always taken a leading part in movements relating to the public interest. There is no more serious question before the world than that of adjusting the relations between capital and labor. At this time it is important for the industry to settle its own problem of labor, to set an example, so far as it can do so, to other industries. This question should be taken up, in my opinion, not as a matter of welfare work, but as a matter of equity. What in justice should the industry do to have its bodies of workers feel that they are partners and as partners concerned in the success of the enterprise? My suggestion was that a committee could carry further the work which was done admirably a few years ago by the committee of which Mr. Edgar was chairman. Then any company in the industry will find laid down an equitable plan which it may follow in establishing fair relations with its employees in accord with the new conditions in the world."

Officials of the American Telephone & Telegraph Company Under the New Plan of Organization After the Government Returns the Wires

THEODORE N. VAIL

chairman of the board of directors, who will devote his attention to the larger problems of the corporation.

H. B. THAYER

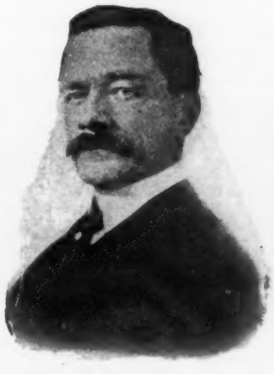
the new president, has been identified with the system for forty years in manufacturing and administrative capacities.

N. C. KINGSBURY

first vice-president, has been concerned with both operation and public relations of the company.

N. T. GUERNSEY

vice-president, in charge of the legal department, has been general counsel of the system for a number of years.



COL. JOHN J. CARTY

vice-president, in charge of development and research, has long been head of research, experiment and development work.

W. S. GIFFORD

vice-president, in charge of accounting and finance, has hitherto been comptroller of the company.

BANCROFT GHERARDI

chief engineer, has been Colonel Carty's chief aid and acting chief engineer of the company during the war.

CONGRESS SETS DATE FOR RETURN OF WIRES

Conference Committee Comes to Agreement—Systems Will Probably Be Given Up Aug. 1—Present Rates to Remain in Effect Ninety Days

Conferees from the Senate and House of Representatives came to an agreement on Tuesday of this week as to the terms of legislation for returning telephone and telegraph lines to private control. The bill, which then went to both houses for ratification, provides for return of the wires at midnight of the last day of the calendar month in which the law is approved by the President. This means that government control will probably end Aug. 1, as President Wilson is expected to sign the measure early next month.

The Senate and House compromised on the question of continuing toll and local exchange telephone rates, which will remain in effect for four months unless sooner changed by state commissions. The Senate bill prescribed originally a rate extension of ninety days, while the House measure provided for a continuation for six months.

The plan for return of the wires on the last day of the month was adopted to avoid complications in accounting which would occur if the government should relinquish control in the middle of a month, as the Senate bill provided.

EMPLOYEES REPRESENTED ON BOARD OF DIRECTORS

Men and Women Working for St. Louis Central Station Are Given Voice in Management of Company—W. T. Beam Chosen

A long step forward in relations between utilities and their employees is credited to the Union Electric Light & Power Company of St. Louis, which invited its employees to elect one of their number to represent them on the board of directors of the company.

Following the practice of the Employees' Mutual Benefit Association the election was conducted by secret ballot, and ballot boxes in charge of members of the association were used. The honor and responsibility of being the first one to represent the employees in the councils of the company was given to William T. Beam, senior watch engineer of the Ashley Street power plant. Mr. Beam was born in California, Mo., 150 miles from St. Louis, in 1873, and he has been in the employ of the company for about fourteen years.

CHANCES ARE NOW GOOD FOR WATER-POWER LEGISLATION

Action in Congress This Week Greatly Strengthens the Hope for the Enactment of a Law That Will Conserve and Apply Water-Power

Chairman Esch of the interstate and foreign commerce committee of the House of Representatives asked unanimous consent during the early part of this week that the water-power bill be taken up for consideration and passed by the House on Thursday afternoon. He was suported by Mr. Sims of the Democratic side, and the unanimous consent was granted.

The Washington representative of the ELECTRICAL WORLD telegraphed that the bill would undoubtedly be passed at that time without much debate and probably without the change of a word. It is the Esch bill, which is identical with the bill reported out of conference and approved by the House at the last session.

Both the commerce committee of the House and the public lands committee of the Senate have appointed sub-committees of five on the water-power question, and these committees will confer with the hope that both committees will be able to get behind the same bill, which, while it will differ somewhat from the House bill, will be along the same general lines.

It would seem almost certain that water-power legislation of a workable nature will be enacted at the present session of Congress, according to the information obtained by the Washington representative of the ELECTRICAL WORLD.

TRADE CONDITIONS AS THEY ARE FOUND IN EUROPE

Frank E. Watts, After Journey in Interest of Electrical Manufacturers' Export Association, Discusses Situation in Various Countries

Frank E. Watts of F. E. Watts, Inc., has returned to New York from a trip to Europe which he made in the interest of the Electrical Manufacturers' Export Association, of which he is president. This association, as stated in the ELECTRICAL WORLD on March 22, is composed of electrical manufacturers in non-competing lines.

On his trip, which lasted ten weeks, Mr. Watts visited England, France, Belgium and Spain. In speaking to a representative of the ELECTRICAL WORLD about the conditions which he found, he said that English manufacturers told him that "American competition is clean." They expect to find American competition and are prepared to meet it. There will be a market in the British Isles for specialties, Mr. Watts believes.

In France the import restrictions, carrying also restrictions against payment in money for foreign goods, combine with the present unfavorable rate of exchange to prevent trade. All kinds of rumors are afloat concerning the policies which will be adopted in future. The need for materials is so large that Mr. Watts expects there will be a large amount of business for American manufacturers in Europe when trade can be resumed.

Conditions in Belgium are not hampered by restrictive regulations at present, and Mr. Watts found in that country a general desire to do business with the manufacturers of the United States. As the country is absolutely stripped its needs are large. In Belgium as well as in France it will be necessary to arrange for credits on a basis that will enable the foreign buyers to finance their purchases without strain.

Mr. Watts obtained the impression that Germany will not have sufficient financial power to become a large factor in world trade for several years. He is also of the opinion that the Scandinavian countries, excepting Sweden, will be large buyers in America. During his stay in Spain he found that that country, which has become rich during the war, is manufacturing many lines of electrical materials. Among these are pole-line hardware, transformers, motors, electrical measuring instruments, switches, sockets, receptacles, fuses, porcelain, wire and cable, bells, marine fittings, etc.

BOSTON EDISON COMPANY SELLS $6,000,000 NOTE ISSUE

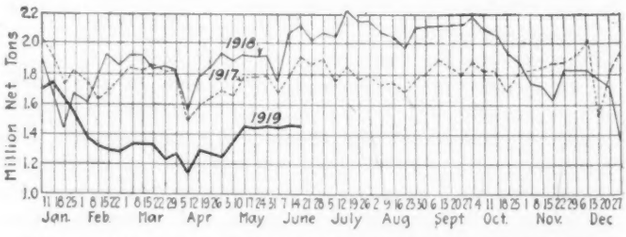
President Charles L. Edgar Says that $3,000,000 of the Funds Are Needed for General Extension and Enlargement of Distributing System

An issue of $6,000,000 of 6 per cent notes has been sold by the Edison Electric Illuminating Company of Boston. It is offered at 99½ by the bankers, Lee, Higginson & Company, Old Colony Trust Company, F. S. Moseley & Company, Kidder Peabody & Company and Parkinson & Burr. The notes are dated July 1, 1919, and are due on Feb. 1. 1922.

In a letter to the bankers Charles L. Edgar, president of the company, says that the proceeds will be used to retire $3,000,000 notes due on Dec. 1, 1919, and for the general extension of the distributing system. He adds:

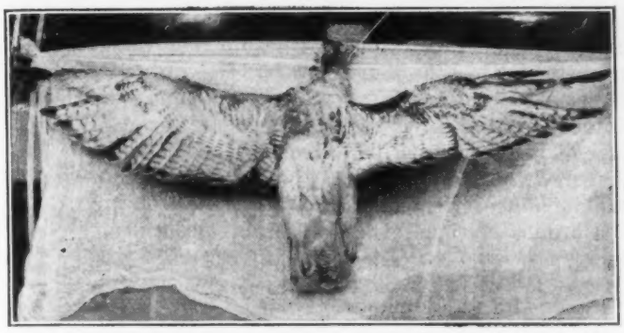
Sufficient funds are in hand from the sale of previous notes to complete the construction program referred to in my letter to you of July 17, 1918. Since that letter was written and the notes to which it referred were issued the armistice has been declared and the growth of the company's business has been along more normal lines than during the war. The restrictions placed upon new commercial business during the war forced the company to concentrate practically all of its efforts upon industries incidental to the war. These restrictions have been removed and the company is now taking on new business more nearly approximating its pre-war policy. Funds will therefore be needed for the general extension and enlarging of the company's distributing system. Before the war it was the company's practice to expend from $2,000,000 to $3,000,000 per year in this class of work. During the war this was reduced to about $750,000 per year, and it is thought that with the proceeds of $3,000,000 notes now being sold to you the company will have sufficient funds for such needs for at least two years.

Bituminous Coal Production Still Under 1917 and 1918 Levels



The weekly report of the United States Geological Survey shows that for the last few weeks the production of bituminous coal has been at about the same rate but still considerably below the record of the last two years.

Birds Also Cause Outages



A chicken hawk, laid out for the camera, after getting mixed up in one of the 33,000-volt lines of the Iowa Railway & Light Company.

REVISIONS CONSIDERED FOR NATIONAL ELECTRICAL CODE

Electrical Committee of National Fire Protection Association Announcements in Regard to Work of Preparation for the 1920 Code

The electrical committee of the National Fire Protection Association in its work of preparation for the 1920 National Electrical Code wishes that all who are interested shall be kept advised of the subjects under consideration and be given an opportunity to present suggestions and recommendations to its sub-committees.

With this object Dana Pierce, chairman of the committee, has made public the following:

Revision of Rules on Motors and Motor Fuses.—Several questions on motors and motor-fuse protection are under consideration by the electrical committee of the National Fire Protection Association in its work of preparation for the 1920 edition of the National Electrical Code. The investigations are being conducted by the standing committee on industrial applications, under whose direction several technical sub-committees have been appointed.

Among the topics receiving attention are the following:

The general question of the size, location and installation of fuses designed for the protection of motors and their starting devices as distinguished from other fuses primarily intended to protect the main or branch feeders. It is expected that more definite and readily applicable rules can be formulated on this very important matter. (Rule 8.)

Present rules limit quite closely the use of oil-filled transformers in industrial applications in buildings, and this subject is again being reviewed. (Rules 11 and 36.)

A clarification of the rules on the installation of starting devices is proposed especially as regards distinctions between direct-current and alternating-current apparatus and the disconnecting switches now called for with autostarters or compensators (Rules 8-c and 8-d).

It is possible that some provision can be made to permit the application of a demand factor in certain types of motor-driven equipments which will reduce in a specified manner the necessity of running supply circuits of the larger current-carring capacity now required by a rigid interpretation of present rules.

Other questions are those of fireproof motor rooms or inclosures and the grounding of motor and generator frames.

Persons having suggestions or recommendations on the Code rules covering these topics are invited to communicate with G. S. Lawler, chairman of the standing committee on industrial applications, 31 Milk Street, Boston, Mass.

Revision of Code Rules.—The standing committee of the electrical committee of the National Fire Protection Association on cars and railways has under consideration the revision of the requirements of the National Electrical Code on wiring of carhouses and the equipment of cars.

In addition to a review of the present rules attention will be given to the question of formulating rules applicable to railway systems and cars operating at voltages from 600 to 1500.

In this work two special committees of the American Electric Railway Engineering Association are coöperating.

Any one having suggestions or recommendations on the code rules covering these subjects is invited to communicate with the chairman of the standing committee, Martin Schreiber, Public Service Railway Company, Newark, N. J.

CO-OPERATIVE COURSE IN ELECTRICAL ENGINEERING

Arrangement of Massachusetts Institute of Technology and General Electric Company for Distinctive Training Will Be Re-established

The co-operative course in electrical engineering which was established under the joint supervision of the Massachusetts Institute of Technology and the General Electric Company is to be re-established in the autumn. It was established in 1917. On account of the Student Army Training Corps course established at the engineering schools in the fall of 1918 it was found necessary to omit the co-operative course during that year.

This course is conducted by the Massachusetts Institute of Technology in co-operation with the General Electric Company and it affords a distinctive training for the technical and executive responsibilities of the manufacturing industries. The course covers a period of five years, of which the first two are identical with the old and well-established course in electrical engineering at the Institute and the last three are divided between instruction at the institute in Cambridge and experience associated with instruction at the West Lynn and other works of the General Electric Company. The work of the final year of the course is of advanced nature, with emphasis laid on the problems of administration, the design and development of engineering projects, and creative work such as research. The training at the works of the General Electric Company is laid out and conducted with a view to the maximum educational value and is intimately correlated with the instruction at the institute.

The co-operative training which occupies the last three years of the course will be entered upon by the new class on Oct. 6 of this year. The successful completion of the course leads to the degree of master of science. The number of men who may be admitted each year is at present limited to forty, and candidates for admission are subject to the approval of both the Institute of Technology and the General Electric Company. Students who have successfully completed the first two years of the electrical engineering course of the Institute of Technology are eligible to enter this co-operative training, and well-qualified students who have completed the substantial equivalent at other institutions are also eligible for admission.

While students are at work at the General Electric Company they receive regular compensation but are under supervision of teachers, and their work in the shops is supplemented by conferences with works department heads in which technical and administrative problems which arise from time to time at the works are discussed.

IOWA MEETING BRINGS FULL DISCUSSION OF MANAGEMENT

Rates, Municipal Ownership and Service for Farmers Are Topics in Which Central-Station Men Show Interest

Of the recent central-station conventions in the Middle West, the eighteenth annual meeting of the Iowa Section, National Electric Light Association, at Colfax, Iowa, June 18, 19 and 20, was most lively in point of business discussion. President H. Bellamy of Knoxville was compelled in almost every session to limit the free discussions on the topics presented. Those phases of the business which claimed the greatest attention of the delegates were more uniform rates, methods of handling municipal ownership adjudication, and methods of providing transmission line service for farmers.

In his annual address President Bellamy suggested some important changes in the plan of operation of the association. During the past year Rex H. Fowler, Des Moines, has been made assistant secretary of the association and has opened a permanent office for the section at Des Moines. To carry out further this idea of active association work, Mr. Bellamy advised that the executive committee of the association be enlarged in number and that the following additional active committees be organized: Finance, convention, membership, legislative, engineering, accounting, public policy, rates and publicity.

FACED WITH A NEW PRICE LEVEL

In reviewing the situation among Iowa utilities during the last year, President Bellamy expressed the belief that operators were faced with a new price level which would not be materially reduced. This being true, rates for electric service which were reasonable and compensatory prior to the war have become entirely inadequate. The increase in the price of steam coal of approximately 300 per cent and of labor of approximately 100 per cent, as well as the advanced interest rate on the securities of utility companies, together with other cost increases, constitute a gap which cannot be bridged by any operating economies that might be utilized in a business already conducted with high efficiency. Mr. Bellamy also pointed out the need for legislative action which would compel the use of better accounting systems by municipal plants.

The prearranged convention program consisted of the following papers: "Rate Litigation in Iowa," by William Chamberlain, general counsel United Light & Railways Company; "The Iowa State Board of Conciliation —Its Work and Possibilities," by William G. Raymond, dean engineering department, State University of Iowa; "Rates as Affected by the Increased Cost of Production, and the Attitude of Regulatory Bodies Thereto," by F. A. Warfield, rate engineer Illinois Traction System, Peoria; "Principles to Be Observed in Determining a Rate for Electricity in Cities Under 5000 Population," by J. B. Hill, professor electrical engineering, State University of Iowa; "The N. E. L. A. System of Accounting as Applied to Small Plants," by W. A. Jones, secretary Empire District Electric Company, Joplin, Mo.; "Meter Testing for the Small Electric Company," by F. D. Paine, associate professor engineering department, Iowa State College; "Public Utility Regulation," by John F. Gilchrist, vice-president Commonwealth Edison Company, Chicago; "The Plan of Operation of the National Electric Light Association," by E. W. Lloyd, general contract agent Commonwealth Edison Company, Chicago; "The Electric Transmission Line and Telephone Interference Situation in Iowa with Respect to Farm-Line Service," by Howard S. Phelps, electrical engineer Iowa Railroad Commission, Des Moines; "Electric Service for Farmers," by A. H. Latimer of Colmar and P. H. Atwood of Armstrong; "Municipal Ownership in Iowa," by A. Huntington, Cedar Rapids, and "The Menace of State Socialism," by F. G. R. Gordon, National Electric Light Association, New York.

LEGAL SITUATION IN IOWA

Mr. Chamberlain's address was a masterly statement of the legal situation in Iowa, where the utilities in order to secure much needed rate increases have taken their cases into the federal court. The final results of this procedure will not become known until the Supreme Court has rendered a decision in the matter. Dean Raymond's paper was a historical treatise setting down the facts about the conciliation board which was formed at the suggestion of Federal Judge Wade to make an amicable disposition of the many rate cases that reached his court. While this board has performed a remarkable service during the war, it will pass out of existence with the signing of the treaty of peace, as it was organized on a purely temporary basis.

The paper by Mr. Warfield was an array of logic and data to show that the present high costs are permanent. Mr. Warfield expressed the opinion that it will be impossible for utilities to bridge the gap in their financial situation by means of operating economies. More money from the consumers in the way of increased rates will be necessary if the utilities are to survive. Professor Hill's paper reviewed all of the more common forms of electric service rates used in the United States and concluded with an expression of opinion that a rate consisting of a readiness-to-serve charge and an energy charge—that is, something in the nature of a combination of the Hopkinson and the Doherty rates—would prove most advantageous for central stations in Iowa.

Discussion of these papers brought out in an impressive manner the desirability of securing a uniform method of arriving at rates throughout the state. Where city councils regulate rates for each local community and where towns are numerous and distances are short, as they are in Iowa, there is apparent a very decided tendency to compare the rates of one company in its town with the rates of another company in the towns where it may be operating. When no uniformity of rates or of rate-making exists, utilities sometimes find it difficult to offer a satisfactory justification of rates which they seek from a city council.

The major portion of Mr. Jones' paper consisted of an explanation of the standard classification of accounts recommended by the National Electric Light Association with a view to emphasizing its flexibility. Mr. Jones urged the larger companies of the state to aid the smaller companies in installing better accounting systems, if this should prove necessary, in order to protect themselves against the small company which sells below cost because it does not know its cost, and thereby reflects discredit on the industry. Many questions regarding methods of handling depreciation on lines which have been required through various contracts with farmers constituted the principal discussion on Mr. Jones' paper.

In his paper on meter testing, Professor Paine told of the short course for the education of metermen which the Iowa State College conducted last year and will conduct again this year. One delegate who had attended this short course testified to the benefit which the thirty-five students had received from its teachings last year.

ADDRESSES OF MESSRS. GILCHRIST AND LLOYD

The addresses of John F. Gilchrist and E. W. Lloyd of Chicago, which were delivered at the annual banquet of the association, were among the features of the convention. The subjects on which Mr. Gilchrist touched were utility publicity, utility securities, the advantages of commissions over local city council regulation and the development of good will. A report of a similar address by Mr. Gilchrist was given in the ELECTRICAL WORLD of June 21, page 1331. Mr. Lloyd predicted that there was a live year ahead for the national association and expressed the belief that a very much more important part would be played by the geographic sections, these bodies taking up more of the detailed association work than they had been doing in the past, leaving the national association free when the plan has been worked out to devote more of its time to the broader questions affecting the industry.

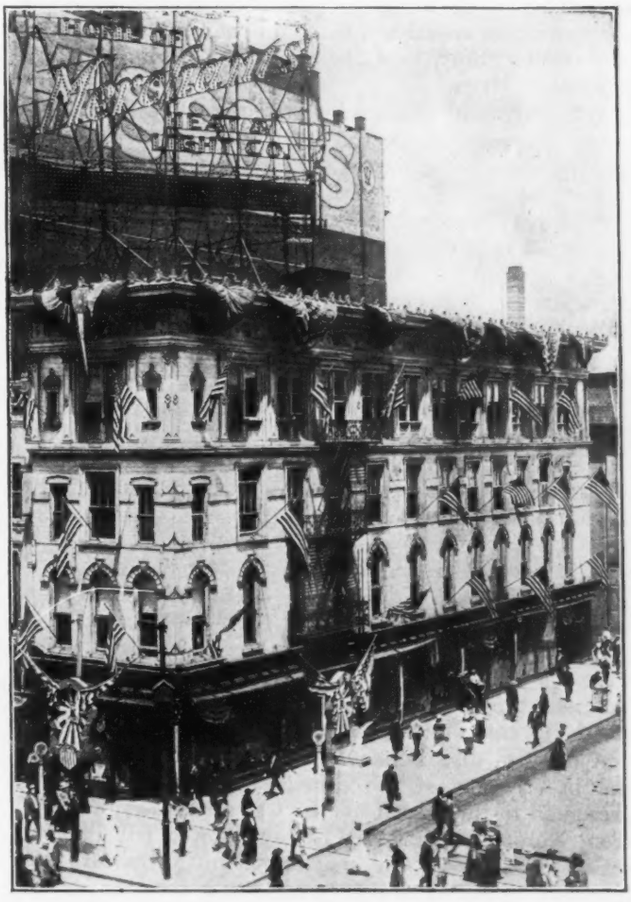
There were three addresses dealing directly with municipal ownership and socialism. Mr. Huntington cited figures regarding the operations of several Iowa municipal plants, showing that they were using tax money to make up deficits incurred in operation. Mr. Gondon, publisher of *Public Service*, read a short paper dealing with the work which he is undertaking in combating municipal ownership. Mr. Gordon's address dealt with the broader phases of government ownership and bristled with data on the unsuccessful operation of many foreign and domestic municipal undertakings.

The important point which appeared in all of the papers and discussions relating to farm lines was that the companies are convinced that they must serve the farmer. The average wealth of the Iowa farmer is at present so great and his demand for electric service is so well recognized that the situation is one in which the utilities are likely to have competition of an undesirable character so far as they refuse service or attempt to discourage the farmer in his endeavor to secure it. Mr. Phelps' paper, in addition to citing sixteen cases in which inductive interference had been encountered and remedied, also gave data concerning farm line specifications which would more nearly comply with the wishes of the Iowa Railroad Commission than some construction now employed by certain builders. Data brought out on farm-service rates show that there has been a considerable stiffening in this matter within the last few years, so that companies are now asking a $5 per month minimum charge plus an energy rate, and there appears to be some doubt as to whether or not even this charge is adequate to cover the cost. Considerable information relative to this point was brought out by Mr. Latimer. Practically all of the farm-line construction seems to be carried on at 2300 volts to 6600 volts. The practice of tapping high-tension trunk lines for individual farm use is being discouraged quite generally. The latest problem which is confronting the companies serving these scattered customers is that of liability insurance to cover property damages occasioned through failure of the apparatus or line. The companies are all carrying their own risks, but many feel they can ill afford to do this as a single loss might wipe out any profit which they will secure from the farm-line business for many years to come. It is probable that the executive committee of the association will collect data which will permit the association to take up the insurance question with the idea of insuring members as a whole.

The report of the legislative committee, of which Frank J. Hanlon of Mason City was chairman, indicated that practically no undesirable legislation had been passed by the Legislature of the state during the past session and that some of the legislation which the utility companies desired had met with the approval of the lawmakers. As one item of particular interest, he mentioned the fact that the workmen's compensation law had been changed so that payments would be increased from 50 to 60 per cent.

The following officers were elected for the ensuing year: President, O. H. Simonds, Dubuque; vice-president, J. P. Ingle, Keokuk; secretary-treasurer, M. G. Linn, Des Moines; directors, B. G. Schmidt of Elkrader, Austin Burt of Waterloo, John Drabelle of Cedar Rapids, F. J. Hanlon of Mason City, Paul Myers of Grinnell, C. G. Johnson of Davenport, Charles Miller of Claremont, C. E. Farney of Ottumwa, C. E. Burke of Sioux City and F. W. Brooks of Omaha.

Decorations on Indianapolis Utility Building in Honor of Shriners



The home of the Merchants' Heat & Light Company of Indianapolis was decorated as shown for the Shriners' conclave, which was held in that city during the week of June 9. The 5-ft. by 8-ft. flags show to very good advantage, and some of the base decorations around the display windows were the subject of favorable comment.

NEBRASKA DISCUSSION ON POLICY AND FINANCE

Technical Subjects Are Subordinated to Those on Public Relations at State Annual Convention—T. H. Fritts Made President

At all of the sessions of the annual convention of the Nebraska Section, National Electric Light Association, at Grand Island, Neb., June 18 and 19, references to the public feeling toward utilities constantly cropped out. Major J. L. Cleary of Grand Island mentioned it in connection with an address of welcome, in which he referred to the city's municipal light and power plant as "something that kept him busy writing checks that totaled close to the entire income of the plant."

President J. E. Davidson of Omaha dwelt on the topic of policy at some length. He told how the high cost era had affected Nebraska stations and stated that only in a few cases had it been possible to secure relief from higher rates on account of the lack of sympathy for utilities among the many local regulatory bodies to which the companies had to appeal. He warned central-station executives against presuming that there would be any great reduction in the costs of operation within the next two years. Some Nebraska city councils, acting on the assumption that costs will recede, are endeavoring to pass ordinances to eliminate surcharges made effective during the war. The fallacy of such action must, said the speaker, be pointed out to local authorities.

Mr. Davidson also made a strong appeal for more hearty coöperation in the legislative work which the association must undertake from time to time. While in the last year the central stations were successful in preventing the passage of any obnoxious bills, the members must hold themselves ready to assist the industry in times when help is needed. One such time soon to come is the occasion of the formation of the constitutional convention, which will endeavor to present to the people of the state a new constitution. In this work the changed plan of operation of the National Electric Light Association will be of assistance locally.

As one bright ray in the utility situation, the president told of the fuel survey now being made by the Nebraska Power Company. This has brought out that some of the Kansas coal men are somewhat worried over the fact that certain large industries and utilities in Nebraska are tending to favor Illinois coal. Only recently the Kansas coal operators contemplated a reduction in price to $2.50 a ton to meet this situation, but as yet the reduction has not been made. This situation may remain unchanged until the peace treaty has been signed and the subsequent wage demands which the coal miners will then make have been settled.

A detailed discussion of the dire possibilities to capital in the acts of the constitutional convention was presented to the association by Charles Kelsey, a lawyer from Norfolk, Neb. Mr. Kelsey pointed out that the action of this body will be as important to the corporate interests of the state as twenty-five sessions of the Legislature, because the new document which it will prepare will become the basic law of the state. Moreover, it can act without precedent and with practically unlimited power. Its action toward utilities will follow one of three plans, as follows: First, it may merely mention them, which is improbable; second, it may provide for state or municipal ownership, which is likely to be proposed but unlikely to pass, because of the general knowledge of the failure of the government's attempt at utility operation; third, it may provide for some form of regulation, in which event central stations must see to it that the regulation is not of a confiscatory nature. The new constitution will no doubt also contain a clause on water power. In the meantime Mr. Kelsey advised the utility men to take steps to educate the public, as it will be the final judge of the new constitutional provisions.

Other papers dealing with phases of public relations were "Sale of Utility Securities to the Public," by J. R. Smith, Omaha; "Attitude of the Public Toward Utilities," by Frank E. Helvey, Lincoln, and a paper entitled "The Man in the Street," which was written by S. M. Kennedy of Los Angeles and read by R. J. Andrus of Grand Island. The technical and business papers presented were "Modern Steam Central-Station Practice," by H. A. Lynette, Chicago; "Safety Measures and Accident Prevention," by Charles B. Scott, Chicago, and "New Business," by W. S. Byrne, Omaha.

P. A. B. Sahm of the Bureau of Standards was present at the convention and discussed with the operators some of the features of the field survey which the bureau is now making to determine the workability of the National Electrical Safety Code. Investigations in Nebraska on lines which operators feared were substandard have showed that these lines do meet the requirements of the code. There seemed to be some sentiment against revising the requirements of the rules upward.

On the last afternoon of the convention the delegates were driven about 25 miles out to the hydroelectric station of the Central Power Company at Boelus. Officers elected for the ensuing year were: President, T. H. Fritts, Grand Island; vice-president, James B. Harvey, Omaha. The secretary's office will probably become appointive with the change to a paid secretary.

CHEMICAL ENGINEERS TALK ON THE ELECTRIC FURNACE

American Institute, Gathered at Boston, Devotes Day to Subject—Papers on Various Types of Furnace

The American Institute of Chemical Engineers, which held its eleventh semi-annual meeting at Boston, Mass., from June 18 to 21, devoted the sessions of the first day to a symposium on electric furnaces. C. W. Bragg, Michigan Smelting & Refining Company, introduced the subject with a talk on "The Future of the Electric Furnace," followed by "The Utilization of Electric Brass Furnaces," by W. H. Gillette, Bureau of Mines, and "Electric Furnaces of the Resistance Type," illustrated by motion pictures, by T. F. Bailey, Electric Furnace Company. In the afternoon the following papers were presented: "Ajax Wyatt Induction Furnace," with slides, by G. H. Clamer, Ajax Metal Company; "Some Practical Results Secured with High-Frequency Induction Furnaces," by Dr. E. F. Northrup; "Booth-Hall Rotating Furnaces," with motion pictures, by Carl H. Booth, Booth-Hall Company, and "The Rocking Electric Furnace," by H. M. St. John, Detroit Electric Furnace Company. E. F. Collins, General Electric Company, spoke on the muffle-type electric arc furnace.

ACTION OF CONGRESS ON THE DAYLIGHT-SAVING LAW

Both House and Senate Approve Measures to Repeal the War-Time Act—Attitude of Farmers and Labor

Friends of the daylight-saving law received a severe blow last week when the House of Representatives, by a vote of 233 to 122, passed the bill repealing the daylight-saving law and the Senate, by a vote of 56 to 6, decided in favor of a rider to the agricultural appropriation bill intended to effect the same object.

The House bill was presented by Mr. Esch, chairman of the interstate and foreign commerce committee, and found in him a strong champion. He said that numerous complaints had come from a committee of miners of Indiana and Ohio advocating that the law be repealed. He also pointed out that the early rising hour was a great inconvenience to the farmer. He said in part:

"The hired man on the farm is assimilating some of the doctrines of organized labor in the cities. In many parts of the United States he is claiming an eight-hour day. Suppose he reports at 6 o'clock in the morning, clock time. The dew is yet on the grass and on the fields. He cannot work until the dew has been dissipated, or he engages in some unimportant work until he can get to the fields. That is really lost time to his employer. But when the whistle in the nearby town sounds 5 o'clock he stops. His eight hours are accomplished."

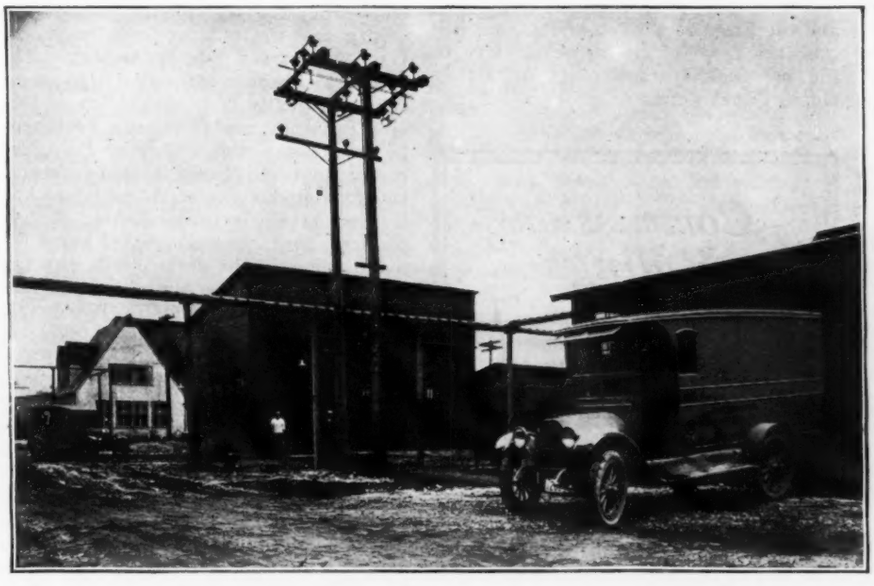
Mr. La Guardia of New York argued in favor of the retention of the law and held that city dwellers were pleased with it and benefited because of its adoption. In answer to the contention that organized labor favored the old time schedule, he read a letter from the secretary of the American Federation of Labor suggesting that arrangements be made for a hearing upon the bill so that those who oppose the repeal of the law could be heard.

Mr. Focht of Pennsylvania declared that the claim of the Fuel Administration that more than 1,000,000 tons of coal were saved last winter because of the daylight-saving provision would not stand the test of either reason or fact. He said that the saving was due to the constant admonition to save coal, the warning that there might be a coal shortage, and to the fact that the winter of a year ago, with which the Fuel Administration compared last winter, was the severest on record, whereas the winter of 1918 and 1919 was one of the mildest experienced since the Weather Bureau was established.

Mr. Garland of Pennsylvania said that the repeal of the law would tend to increase the hours of labor and that such an act would arouse every laboring man in the United States against the advocates of the old time standard

In the Senate the amendment to the Agricultural appropriation bill was sponsored by Senator La Follette. Senator Calder of New York made a statement in favor of the retention of daylight saving.

Electricity's Part at the United States Naval Training Station at Great Lakes, Ill.



The United States naval training station at Great Lakes, Ill., will in all probability be one of Uncle Sam's great permanent naval universities. Electric service established for it during the war is delivered through two combination indoor-outdoor substations. One is rated at 1500 kva., 22,000/4000/2200 volts, and the other at 900 kva., 22,000/2200 volts, energy being supplied from the lines of the Public Service Company of Northern Illinois. The output of these stations has dropped off some since the signing of the armistice but is still at a fairly high figure. For instance, on Jan. 24, 1919, the maximum demand on the 900-kva. station was 912 kw., and on Feb. 7 it was 852 kw. On the 1500-kva. station the maximum demand was 1220 kw. on Jan. 31, 1919, and 848 kw. on Feb. 7. The energy consumption from the two stations totaled 614,600 kw.-hr. in January, when 28,000 men were in camp, and 500,600 kw.-hr. when 22,000 were on hand. In these months the relative consumption was high, ranging around 22 kw.-hr. per capita, because the station's population was low as compared with August, 1918, when it had 48,000 inhabitants. According to L. A. Pease of the public works department of the station, from whom these data have been obtained, a better figure can be had by taking the records for October, when there were 42,000 men in camp and when the total maximum demand on the two substations and the main plant was 2000 kw., or about 0.05 kw. per capita.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Spokane Section.—The June 13 meeting of this section of the American Institute of Electrical Engineers was devoted to a discussion of the metric system.

Joint Excursion of Detroit Engineering Society and Detroit-Ann Arbor Section, A. I. E. E.—The annual excursion of these two organizations to Bob-Lo is to take place on June 28.

Los Angeles Jovian Electric League.—Prof. Kio Sue Inui, University of Southern California, spoke on "Japan's Policies in the East and How They Affect American Interests" at the June 11 meeting of the Jovian Electric League of Los Angeles, Cal.

Massachusetts State Association of Electrical Contractors and Dealers.—Fred W. Lord, president of the Lord Electric Company, New York City, addressed the June 19 meeting of the association, urging a closer association, not only among consulting engineers and electrical contractors, but among contractors themselves.

N. E. L. A., Public Service Section.—This section of the National Electric Light Association elected Franklyn Heydecke, Newark, N. J., as its chairman for the year 1919-1920, and J. T. Foster, Newark, N. J., as secretary, at the annual meeting, which took place June 16. A memorial to the late Paul Lupke was adopted at this meeting.

A. I. E. E., Madison Section.—Prof. C. M. Jansky has been elected chairman of this section of the American Institute of Electrical Engineers for the coming year. At the June 11 meeting C. B. Hayden, electrical engineer, Railroad Commission, discussed the influence of maximum demand on rates, and F. A. Kartak demonstrated the principles upon which most of the modern type of maximum-demand meters are based.

N. E. L. A., Brooklyn Company Section.—The annual meeting of this section of the National Electric Light Association was held on June 10, with more than 500 in attendance. E. A. Baily was elected chairman for the coming year and F. J. Farley secretary. During the past year no papers were presented at the section meetings; instead, some individual prominent in national or local circles gave an address on a timely topic, and the remainder of the evening was usually devoted to entertainment. All of these meetings were thrown open to the members of the company regardless of whether they were members of the section or not.

American Association of Engineers, Portland Chapter Formed.—A Portland (Ore.) Chapter of the American Association of Engineers has been formed with W. H. Marsh as its president and R. W. Barnes as secretary.

A. I. E. E., Pittsfield Section.—R. E. Wagner and N. F. Hanley have been elected chairman and secretary-treasurer respectively of this section of the American Institute of Electrical Engineers for the season 1919-1920.

A. I. and S. E. E., Cleveland District Section. — The next meeting of this section of the Association of Iron and Steel Electrical Engineers will take the form of an outing, which will be held in July at the Old East Shore Country Club.

A. I. and S. E. E., Philadelphia Section.—Fred H. Woodhull, superintendent of the electrical department, Lukens Steel Company, Coatesville, Pa., has been elected chairman of this section of the Association of Iron and Steel Electrical Engineers for the coming season.

District of Columbia Association of Contractor-Dealers.—J. C. McLauglin, commercial manager of the Potomac Electrical Company, Washington, D. C., has been elected chairman of this association and L. D. Carroll of the Carroll Electric Company, Washington, D. C., secretary.

A. I. E. E., Panama Section, and Engineers' Club of Panama.—The July meeting of the Panama Section, American Institute of Electrical Engineers, and the Engineers' Club of Panama will take the form of an inspection trip to the new cold-storage plant at Mount Hope, Canal Zone.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Prohibitively High Rates.—In deciding to decline rates asked by the Ava Electric Light Company the Missouri Public Service Commission declared that although existing rates for electric energy result in a loss and a proposed increase in rates does not permit of a reasonable return to a hydroelectric utility, prohibitively high rates—maximum, 20 cents per kilowatt-hour—would not be approved where it appears that an increase in rates will result in decreased returns through the discontinuance of service, and a readjustment of rates may result in increased returns through the sale of all available energy, as a fair return on public utility investment is secondary to the utility's obligation to serve the public. It is unreasonable that a water-power electric system should demand higher rates than a fuel-burning system, the commission said. The decision states: "It is, therefore, considered unfair to the community to allow the increase as asked for and that such rates would not profit the company. If the company will prepare and submit to the commission full consumers' data, its experts will assist the company in preparing a rate schedule with rates arranged in blocks in such a manner as to stimulate the use of electric energy by the inhabitants of Ava, and thus eventually the company will earn greater revenues. This course is deemed wiser than to strangle the present consumption of electric energy by means of prohibitively high rates."

Making Service Remunerative.—Increased rates for general consumers, but not for street lighting, were authorized by the Illinois Public Utilities Commission in a decision affecting the Dahlgren Electric Light Company. The commission said in part: "Evidence discloses that the financial resources of the village are such that, under present conditions, it would be unable to pay the increased rates for municipal lighting. Obviously under such conditions the increase of rates could afford to the petitioner no increase of revenue and would only result in the village being inadequately lighted with very little corresponding saving on the part of the utility. Until such time as the village is able to readjust its finances by means of new appropriations, the commission believes that it would be unwise from the standpoint both of the utility and the village to increase the rates for street-lighting service. The commission appreciates that the operation of a utility in a community of this size presents many serious problems. In many ways the village of Dahlgren is fortunate in being able to receive twenty-four-hour electric service and if this service is to be continued it is obvious that arrangements must be made whereby the service will pay the utility operators the actual cost of rendering the service plus a reasonable return upon the actual capital invested. Otherwise the natural outcome of the entire undertaking will be that the service will become poorer as the utility attempts to economize in its operations and the village will be inadequately served. This condition would continually become more aggravated with resulting losses of consumers until the system will have to be discontinued. The commission wishes to urge upon the Dahlgren Electric Light Company and the citizens of Dahlgren that a concerted effort be made to increase the business of the company to a point where it will be remunerative. In any community it is essential to the best interests of all concerned that the utility, the municipal authorities and the citizens sholl coöperate in order that the city may receive the full benefit of the service. This is particularly true in a community the size of Dahlgren, and the necessity of such coöperation can scarcely be overemphasized."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Ex-Soldiers Choose Electrical Work.—Classification of the cases approved for training by the Federal Board for Vocational Education shows sixty-one former soldiers enrolled in electrical engineering courses, according to the "Vocational Summary" for May. In addition, there are 178 electricians, thirteen electrical bench workers, three power plant operators and sixteen students of wireless.

Announce Civil Service Examinations.—Several examinations for electricians and radio experts are announced by the United States Civil Service Commission. On July 8 there will be tests for expert radio aid, laboratorian, radio, and laboratorian aid, radio, and on July 23 for electrical assistant. Vacancies in the navy department at Washington and in the navy yard service throughout the country will be filled from the examinations.

Electrical Manufacturers Share in Cincinnati Promotion.—The manufacturers' division of the Cincinnati Chamber of Commerce, which was recently formed to take care of the interests of the different industries, embracing country-wide advertising and proposed legislation, has received the electrical manufacturers as a subsidiary group. J. C. Hobart of the Triumph Electric Company was chosen chairman, and representatives of all the electrical manufacturing concerns in the greater Cincinnati territory attended the meeting at which the movement was indorsed.

New York Electrical Show to Be Resumed.—The Electrical Exposition and Motor Show is to be resumed in New York this year, opening at the Grand Central Palace on Sept. 24. This will be the first show since 1917, last year's display having been omitted because of the war. In announcing the resumption Arthur Williams, president of the Electric Show Company, said that while there had been some uncertainty as to the time and place of the exposition, there had never been any doubt that the first year of peace would see the exposition back in its accustomed place. In fact, the show plans began to take form soon after the armistice was signed. The Grand Central Palace was used during the war as a debarkation hospital. An indication of the importance with which the electrical industry regards this show is seen in the fact that 40 per cent of the space had been assigned to exhibitors before the date of the exposition had been finally set tled upon.

Glass Company Appeals on Rate.—Declaring that its requirements from the standpoint of service are extremely favorable to the power company, the Illinois-Pacific Glass Company has applied to the California Railroad Commission for an order approving the 1916 contract the company proposes to renew with the Great Western Power Company. In asking that the commission approve a rate of 1 cent per kilowatt-hour for direct current and 7.8 cents per kilowatt-hour for alternating current, the glass company says that its demand for energy is regular and constant and therefore deserving of the terms sought.

To Improve Broadway Lighting.—The Broadway Association, an organization of New York business men, has inaugurated a campaign for better lighting of the city's chief business thoroughfare. Jefferson Q. Thompson, president of the association, has appointed a committee to study the situation and to make recommendations to city officials. Among the members are A. F. Berry, United Electric Light & Power Company, and C. L. Law, New York Edison Company. A recent demonstration in which lights in private buildings were turned off for several minutes showed the inadequacy of the present municipal lighting.

Widespread Use of Electric Trucks by Bakeries.—A. Jackson Marshall, secretary of the Electric Vehicle Section, National Electric Light Association, has issued a statement showing that representative bakery concerns in this country have selected after exacting tests the electric commercial vehicle as the mode of transportation best suited to their business. The Ward Baking Company employs about 225 electric delivery wagons; the Consumers' Bakery Company, Kansas City, Mo., uses more than sixty electric trucks, and the Mills-Fox Baking Company, Detroit, more than fifty. The Campbell Baking Company of Kansas City employs thirty-five electrics. Kansas City is a city of hills but the electric trucks used daily there by the two bakeries climb them easily.

Norway's Great Water-Power Resources.—Norway possesses more water-power in proportion to population than probably any other country, says a report of the United States Department of Commerce. The developed horsepower per capita is also larger than in any other country. The population of Norway is 2,500,000 and the developed hydroelectric power is 1,300,000 hp., which gives more than 0.5 hp. for every person in the country. The corresponding figure for Sweden is 0.17 hp. In the past few years the Norwegian government has bought a large number of waterfalls in all parts of the country, and it now owns more than 1,500,000 hp. From 200,000 hp. to 300,000 hp. are being held in reserve with a view to ultimate electrification of the Norwegian state railroads. Only a small portion of the state's water powers are under development.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Depreciation of Land Values.—The Court of Appeals of Kentucky has pointed out (211 S. W. 153) that where a right-of-way is condemned through land, cutting it into two parcels, pointed at each end, it is a matter of common knowledge that the lands not taken are materially depreciated in value.

Charges Rendered or Materials Furnished.—The Supreme Court of Appeals of West Virginia has pointed out that services rendered or materials furnished to public service corporations subject to the provisions of the public service commission act must be compensated for by payment in money, not by a pass, and a contract for a pass, though valid when made, becomes illegal and unenforceable under the provisions of the act (9 S.E. 207).

Regulation by Contract or Ordinance.—It has been held by the Supreme Court of Minnesota (172 N. W. 217) that the rates charged by a public service corporation for service furnished to the inhabitants of a municipality may be regulated by contract as well as by ordinance. Regulation by ordinance calls for the exercise of governmental functions, and by contract for the exercise of the business or proprietary powers of the municipality.

Rights of Electric Railway and Highway Traveler.—The Supreme Court of Appeals of West Virginia has held that the recognized legal status and reciprocal duties each toward the other of an interurban railway company and a traveler on a rural highway at a public grade crossing are materially different from those prevailing in a municipality, the rights of the traveler ordinarily being subordinate to those of the company, in that to the latter is accorded priority of passage, and the reciprocal rights and duties of the respective parties in such case being predicated upon that basis (99 S.E. 180).

Personal Judgments for Damages.—Although a corporation vested with power of eminent domain, having undertaken to condemn land for its necessary use under the state statutes, might, after judgment and before possession is acquired, elect to take or not the land in question, this right of election having once been exercised is, under such statutes, the bill of rights and the constitution, binding upon the corporation, and a personal judgment may be rendered against the corporation in the circuit court, where jury awarded damages exceeding amount of deposit made, according to Court of Appeals of Kentucky (211 S. W. 193.)

W. D. Weaver, formerly editor of the ELECTRICAL WORLD, has received the honorary degree of LL.D from Kentucky University, at which Dr. Weaver was a student prior to entering the United States Naval Academy.

A. P. Merrill has been made manager of the Ogden division of the Utah Power & Light Company. Mr. Merrill succeeds P. M. Parry, who has been advanced to the position of commercial manager of the company.

Lewis A. Lewis has recently been appointed sales manager for the Washington Water Power Company at Spokane, Wash., and J. F. Farquhar general agent for the Palouse and Big Bend districts. Both men have won their promotion through several years of service with the company.

J. C. Johnson, formerly of Davenport, Iowa, has been made general manager of the Iowa Southern Utilities Company, with headquarters at Centerville, Iowa. D. G. Fisher, the newly elected president of the company, will maintain his headquarters at Davenport and will divide his time between Centerville and Davenport.

Anton G. Hodenpyl, who has retired from the presidency of the Commonwealth Power, Railway & Light Company, Grand Rapids, Mich., on account of ill health, will be succeeded by George F. Hardy, vice-president of the company. Mr. Hodenpyl has been president of the company since its organization about ten years ago. He will remain a member of the board of directors.

J. R. Roberts has been made chief engineer of the Central Illinois Public Service Company, with headquarters at Mattoon, Ill. He will serve under the direction of B. F. Tucker, general superintendent of the company. The Central Illinois Utilities Company has had no chief engineer since A. J. Authenreith resigned to go with the Middle West Utilities Company. Mr. Tucker in the meantime has carried most of the responsibilities of chief engineer in addition to his own work. Mr. Roberts has heretofore been associated with the Wisconsin Gas & Electric Company, with headquarters at Madison, Wis.

J. C. Hail, for the last three years electrical engineer in charge of the bureau of electrical engineering of the Department of Gas and Electricity of the city of Chicago, has joined the engineering force of the Pierce Electric Company of that city, contracting electrical engineers, who are expanding their organization to engage more extensively in power-station and substation construction work. Mr. Hail's activities for the last three years have been principally confined to the engineering and supervision of the addition to Chicago's electric street-lighting system, to cost $3,750,000. His previous experience was obtained with Sargent & Lundy, H. M. Byllesby & Company, the Public Service Company of Northern Illinois and the Sanitary District of Chicago.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Col. H. M. Waite has been appointed chief engineer of the Lord Electric Company and the Lord Construction Company. Colonel Waite was graduated from the Massachusetts Institute of Technology and secured his early engineering experience in railway work. In 1912 he accepted the position of city engineer of Cincinnati, Ohio, and in 1914 he was made city manager of

COL. H. M. WAITE

Dayton. He remained in Dayton until 1918, when he entered government service as lieutenant-colonel of engineers. He was sent to France and assigned to the Transportation Department, shortly after being made assistant to General Atterbury, Director-General of Transportation. Later he was made engineer of construction of the Transportation Department, having charge of new work at all ports and on the railways used by the American Army. At the time of taking up this work he was advanced to the rank of colonel. In September last he was sent to the front with the Second Army, and he was assigned to the Third Army in the same capacity after the armistice. When the Third Army was settled in the occupied territory he was detached and sent to Trier, Germany, and placed in charge of all public works in the occupied territory. This position he held until he returned to the United States in February.

John F. Vaughan, formerly manager of the New England district of the United States Shipping Board Emergency Fleet Corporation, has returned to his consulting engineering office at 185 Devonshire Street, Boston. During the war that office has been in charge of his principal assistant, E. A. Ekern.

Frank Steinhart, president and general manager of the Havana (Cuba) Electric Railway, Light & Power Company, has been elected a director in the Sinclair Oil & Refining Corporation, which promises to become one of the largest oil concerns under one management and control.

J. R. Perkins has recently been made assistant to J. S. Pevear, general manager of the Birmingham Railway, Light & Power Company, Birmingham, Ala. Mr. Perkins is an engineer and an expert operating man who has been connected with the operating department of the American Cities Company since 1913.

Raymond H. Smith has resigned as vice-president and general manager of the Eastern Wisconsin Electric Company, with headquarters at Sheboygan, Wis., and as president of the Wisconsin Electrical Association and the Wisconsin Gas Association, to become connected with the Electric Bond & Share Company, New York. Mr. Smith entered the utility field in 1897 at Waterbury, Conn. He has been very successful, particularly in dealing with labor and in building up good public relations. A portrait and a sketch of Mr. Smith's career were published in the ELECTRICAL WORLD of April 5, 1919, at the time of his election as president of the Wisconsin Electrical Association.

Obituary

Paul M. Einert, formerly foreign auditor of the Westinghouse Electric & Manufacturing Company, died on June 5 at his home in New York City. Mr. Einert entered the accounting department of the Westinghouse company at East Pittsburgh in 1900. One year later he was sent to Havre, France, to take charge of the accounting department of the French Westinghouse Company, and in 1905 to the British Westinghouse Electric & Manufacturing Company, Ltd., at Manchester, England, in the same capacity. In 1910 Mr. Einert was appointed foreign auditor of the Westinghouse oompany, with headquarters in London. After the purchase of the controlling interest in the French and Italian companies by the British Westinghouse Company from the Westinghouse Electric & Manufacturing Company, he accepted service with the British Company, as traveling auditor, holding that position until the latter part of 1916. Then he returned to this country as assistant to the comptroller of the Westinghouse company at East Pittsburgh. In January of this year he was appointed special representative to the chairman, with offices in New York, his chief duties being in connection with foreign trade of the company, in which capacity he served until his death. He was fifty-six years old.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

ENLARGED MARKET EXPECTED ON THE SIGNING OF PEACE

Utilities and Industrials Which Have Been Holding Back Are Now Expected to Start a Big Buying Movement

At this writing the table is all set for the signing of the peace treaty on Monday of next week after a wait of seven and a half months. Judging from the amount of construction and development work that has been reported awaiting definite peace, a flood of new business should be loosed shortly.

The bulk of this new business will probably come from industrials and utilities which have held back on any enlargement or change-over plans until they were absolutely sure of being able to go ahead under a peace schedule. For this reason the market for power-plant and line equipment for motors, switches, refillable fuses, lamps, shades, controllers and other industrial electrical materials is apparently on the edge of a large buying movement.

Contrary to the expectation in the minds of many people, peace will not bring an immediate lowering of prices. If anything, the immediate effect of peace will be an advance.

Small materials and wire will probably be first to advance. Apparatus, there are reasons for believing, will remain at current quotations for some time unless the prices of raw materials and labor advance considerably above what they are now. A number of articles did not decline after the armistice, on the theory that the raw materials had been stocked at the peak war prices. Since the first of the year it has been possible to replenish these stocks at very much lower prices. Such products therefore should not go any higher. There have been some labor increases since the armistice, it is true, but these, on the whole, have not been of sufficient magnitude, all things considered, to warrant advanced prices.

Electrical supply jobbers are, on the whole, in an excellent position to take care of any sudden increased demand. Stocks, while not so large as last year, are in reality in better shape because of the improvement in deliveries.

Electrical manufacturers will do well to look to their stocks of raw materials and parts. Prices are now low in comparison with what they will be, and shipments are not likely to be any better this year.

MAJESTIC WINS PORTABLE RADIANT HEATER PATENT CASES

California Jury Holds "Hedlite" Heaters to Infringe Design Patent No. 51,043, Which Was Issued July 17, 1917

The validity of design patent No. 51,043 of the Majestic Electric Development Company of San Francisco, issued July 17, 1917, was sustained on June 16 last, in favor of the Majestic company, in two cases in the District Court of the United States for the Northern District of California. One of these suits was against the Holabird Electric Company and the other one was against Hale Brothers, Inc., R. H. Henderson and the Hotpoint Electric Heating Company, now the Hotpoint Division of the Edison Electric Appliance Company. The cases involved the two forms of the "Hedlite" heater put out by the Hotpoint company. Both of these forms, the Majestic company writes, were held by the jury to be infringements on the design patent.

This type of heater has enjoyed a very large market in the short time it has been out. Prior to its development heater sales were not large in volume. In the past two years the sales of this type of heater have run into very large figures. All of the larger electric appliance manufacturers now have heaters of the same general appearance. An Eastern manufacturer was the last to come out with one, bringing out a round portable heater this spring.

HOLDOVER OF ELECTRIC HEATER STOCKS LARGE

Reports from Different Sections of the Country Indicate Smaller Buying This Fall by Electric Jobbers —Some Orders Placed at Low Prices

A check-up on jobbers' stocks of electric heaters held over from last winter shows that many jobbers still have rather heavy stocks. But a stock of several hundred held over by some jobbers might not be termed by them excessive in view of the number sold. The same number held by other jobbers would, on the other hand, show a poor season or else stocking away out of proportion to the market.

No one will deny that the past winter was warmer than expected. The winter before that, with its extreme cold, exhausted available stocks of electric and oil heaters, and on the strength of that condition manufacturers were ready in the past season to meet a repetition of cold weather. Oil heaters were in sufficient stock and had some effect on sales of electric heaters. Jobbers, of course, had ordered their stocks before the armistice, after which time there was more coal available than there would otherwise have been. This supply of coal and the warm winter combined to make the heater season dull.

Some jobbers with low stocks expect to put in initial orders at the regular time. Others with more or less large stocks say they will dispose of them before ordering anew. In not a few cases overstocks are due to late manufacturers' deliveries.

Although electric heaters are generally termed a seasonable article, they have a light all-year sale. Even now one jobber is getting orders for a dozen at a time for use in summer homes, and he says that he expects to move his left-over stock by fall. Others are finding a light market in summer residences, camps, etc.

Of eight representative jobbers in the New York district, one with only 100 left expects to order 5000 for next season. One with thirty left over anticipates ordering 3000. One with 900 on hand, although having sold a great quantity, would not hazard an estimate of the number to be ordered. Those eight jobbers might be tabulated as follows:

	On Hand	First Order		On Hand	First Order
A	30	3000	F	500	0
B	100	5000	G	700	0
C	120	0	H	900	0
D	200	1000			
E	300	0	Total	2850	9000

SOUTHERN STOCKS CLEANED OUT

A survey of the Atlanta field indicates a small hold-over stock. From information obtained from manufacturers' and jobbers' representatives covering the Southeast it appears that the same condition exists outside of Atlanta. This section has experienced an exceptionally cool spring, which has tended to clean up straggling stocks left over

from the 1918-19 winter season. At the present time there are practically no heaters in Atlanta either in jobbers' or dealers' stocks. Since the armistice the dealers have been especially careful in their buying, and for this reason they have practically no investment in heaters. One large jobber, however, has already placed his order for 1919-20 heaters, and half of this order will come in shortly. He placed this early order on the speculation that prices later on would be higher, and possibly he obtained a slight shade from the market price sufficient to cover interest and storeroom charges up to the time that he would have purchased under normal conditions.

New England Stocks Large

Twenty-seven of the leading jobbers and dealers in New England report 2894 electric radiators now on hand, and their expectation of buying for fall delivery totals 2271 outfits. These jobbers include the larger houses in Massachusetts, Connecticut and Rhode Island as well as smaller houses, and the dealers include representative central stations and retailers selling appliances to the general public. The jobbers' total stock of radiators is reported at 2186, and their expectation of purchase for fall delivery totals 2135. The largest number of radiators reported by any single jobber was 900, with no intention of buying again before fall. Another large jobber, however, with 200 holdover radiators, expects to purchase 1000 radiators for fall and early winter delivery; another with none in stock expects to purchase 500. Nine jobbers intend to purchase no radiators this summer. In a few cases the jobbers are holding off for price reductions; in others the opinion is firmly held that prices will hold at present levels. There appears to be a strong feeling among these retailers in New England that prices will go lower before winter. Most of the jobbers, however, appear to believe that the cost of labor will hold up the price. Frequently the maximum number of radiators on hand at any time since last fall in jobbers' stocks was two or three times the minimum now on hand. Only two of the jobbers reported having no radiators whatever in present stocks. So far price-cutting has not been conducted on a scale sufficient to upset the market as a whole, but one jobber in Massachusetts has been disposing of his holdover stock, about 200 units, at less than half the retail price. So far as can be learned, there was no material shortage of radiators last winter in this section. It may be very roughly estimated that possibly 4000 to 4500 radiators are held over in the principal New England distributing centers and that 3000 to 3500 may be purchased for fall delivery.

Jobbers*	Held Over	To Buy	Jobbers*	Held Over	To Buy
A	900	0	N	100	0
B	200	1000	O	0	20
C	100	0	P	200	0
D	100	0	Q	200	0
E	0	500	—	—	—
F	25	300	27	2186	2135
G	40	200	Ten representative retailers†	708	136
H	12	40			
I	25	0			
J	12	50	Total hold-overs from above representative cases	2994	
K	50	0			
L	110	0			
M	112	25			

* Classified without regard to size or locality.
† Including some of the larger central stations.

Pacific Coast Conditions

The electric radiator season of 1918-1919 in California formed a curious contrast to the heating season of 1917-1918. In the earlier year stocks were hard to get and were doled out in very small quantities to the public. There was hardly a heater left over from the previous season when the present season began last October. In the next place competitive conditions were bad.

During the season just closed no such conditions existed. It is true that stocks were rather late in arriving, but they came in time to handle the emergency orders. The orders, however, that were expected to be built up on sales work did not materialize. At the present time practically every electrical dealer, hardware store and distributer of electrical goods in California has large stocks that will require carrying over until next season because there is no summer radiator season in California.

The jobbers have in the majority placed their orders for next season, so as to secure prompt deliveries in August and September. In several cases these orders have specified delivery within sixty days so as to secure advantage of the old list price of $9 each. The present list ranges from $10 to $10.50.

Climatic conditions in the Northwest are so different from those in the East that the volume of sales of electric heaters does not vary to any great extent. Naturally, the heaviest sales are made in the fall and late winter, but many are sold during the summer months. The cool evenings in this section call for some form of heat in bathrooms and bedrooms, and the electric heaters answer these requirements. For that reason there is a good all-the-year-round demand for these appliances. At present stocks of jobbers and retailers are in good shape. Since the signing of the armistice shipments have been easy to obtain and are coming through regularly. Orders for early fall delivery will be placed about the middle of the summer.

BELGIAN ELECTRICAL PLANTS IN NEED OF RAW MATERIAL

Many Factories Are Ready to Start Production on a Reduced Scale as Soon as the Necessary Material Arrives

Throughout Belgium, in every district and in almost every industry, the cry is the same: Raw material is wanted. The electrical industry, which was once one of the important branches in Belgian engineering, is particularly dependent upon outside supplies of raw material. Copper, of course, is vitally necessary. At least 15,000 tons of copper ingots, sheets, and wire bars, it is reported in the London *Times Engineering Supplement*, are required in the country for the electrical industry (principally) and the requirements of general engineering production, and large quantities of bare and insulated wires and cable. Until supplies come to hand resumption of work in electrical works will not be possible. Already there are a number of factories ready to recommence production on a reduced scale. One cable factory has succeeded in recovering nearly all its stolen machinery and is in a position to start up when material arrives.

Everywhere the demand for electrical equipment is enormous. Apart from that which was commandeered, there is wear and tear and wastage to be made good upon an enormous scale. The central lighting and power stations, the street-railway systems and their power houses, have reached an advanced stage of wear and disrepair. Belgian electrical production alone will not suffice to make the damage good, and so much equipment will have to be purchased abroad.

ELECTRIC SIGN BUSINESS EXCEPTIONALLY GOOD

Prices, While Steady, Are Higher than Normal, and No Immediate Decrease Is Looked for by Producers

Electric sign business since the signing of the armistice has gone ahead by leaps and bounds, and current sales are better than at any previous time in the history of the business. One manufacturer reports that more electric signs were put up in January last than during the whole of 1918. Another reports the demand 20 per cent greater than it was before the war, with export business doubled; while a third states that during the first three months after the armistice was signed it did as much business as it did during the biggest six months in the history of its business. Others report similar conditions for business east of the Rockies.

The rush of business came, of course, with the removal of the war lighting restrictions. To this must be added the after-war boom in advertising and the effect produced by signless nights. As one manufacturer put it, it required

signless nights to teach a good many of the public the real value of electric signs.

Prices generally are higher than they were before the war, owing to increased cost of materials and labor. None of the manufacturers reporting believed that there was any indication of lower prices for some time. While certain of the materials had decreased, it was pointed out that labor was higher than ever. Prices have been steady for some months now, and indications seem to point to a continuation for some time.

The outlook appears bright to the manufacturers, and is expected to remain so, as one producer expressed it, for two or three years.

METAL MARKET SITUATION

Copper Is Quoted at 18¼ Cents—Government Restrictions on Tin Have Been Removed

Copper continues to rise, having come up ¼ cent to 18.25 cents. Prime Lake is up ⅝ cent and casting ½ cent. Wire base has advanced ¼ cent. September, October and November deliveries are quoted at 19 cents. The domestic market has been very firm the past week, but the volume of buying was rather light. The London market for spot copper is up £4, to £86 plus.

Nearly 4000 tons of copper were exported last week, of which France and the Scandinavian countries took 3000 tons. A large percentage of recent shipments was in wire, rods, tubes and bars. The combined foreign and domestic demand is consuming the present curtailed output, so producers are experiencing a feeling of some satisfaction.

It was officially announced on June 23 that all allocated tin has been disposed of, and that licenses for the purchase of tin are no longer required. A careful estimate of the supply of tin on hand in the United States shows there is sufficient, at the normal rate of consumption, to provide for consumptive requirements until the end of October. In order that consumers whose stocks of tin are low may be provided with their necessary requirements, all restrictions on trading in tin between consumers, dealers, jobbers and smelters are immediately discontinued, all guarantees heretofore given under the tin regulations to the contrary notwithstanding. The quotations on Straits tin were opened at 70 cents per pound.

Zinc has responded to considerable activity, and the price has advanced from 6.90 to 7.35 cents.

Other metals show few price changes, and strength is the prevailing feature.

The old-metals market is experiencing some little activity, but the only price change noted is for scrap copper, which is up 1 cent.

NEW YORK METAL MARKET PRICES

	June 9	June 26
Copper:	£ s d	£ s d
London, standard spot	82 5 0	87 5 0
	Cents per Pound	Cents per Pound
Prime Lake	18.00	18.62½
Electrolytic	17.75	18.25
Casting	17 37½	17.75
Wire base	20.00 to 20.50	20.25 to 20.75
Lead, trust price	5.40	5.40
Antimony	8.37½	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.90	7.35
Tin	Govt. price 72.50	70.00
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.00 to 15.50	16.00 to 16.50
Brass, heavy	8.50 to 9.25	8.50 to 9.25
Brass, light	7.50 to 8.00	7.75 to 8.25
Lead, heavy	4.75 to 4.87	4.75 to 4.87
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

BUSINESS conditions throughout the country are gradually getting better, and both jobbers and manufacturers feel more assurance in the growing stability of the market. Building contracts are being let in larger number in all sections, and these embrace more and more the larger commercial structures. The South reports the greatest movement of rigid conduit—the barometer of big building.

Upward price changes are reported in flexible armored conductor and non-metallic conduit; otherwise prices are rather firm, excepting the cutting on schedule material practised by some of the jobbing trade.

Labor difficulties are causing shutdowns in several sections of the country, but no uneasiness is manifest in the outcome.

NEW YORK

With the peace treaty about to be signed jobbers anticipate a better buying movement, while they report business gradually picking up in practically all lines. Prices of both flexible armored conductor and flexible non-metallic conduit have stiffened. The fan business is going along in fair volume, but another hot spell is needed to bring large sales again.

Jobbers' fan sales have increased their month's business to a considerable extent, but there has been little effect on collections. Collections on May sales are coming through in good shape. Many dealers, however, are asking larger credits on account of their fan purchases and in many instances are getting the desired accommodation.

There is a little more unrest in the labor market, although the electrical industry around New York City has not suffered to any extent. The strikes of workers in brass mills in Connecticut are not settled, but they have not spread outside their territory.

Contracting on industrial work is in fair volume; it is running at this time to work incidental to removals from one factory to another or to reconstruction of space and equipment.

FLEXIBLE ARMORED CONDUCTOR.—Prices have stiffened again, this time $2 per 100 ft. Jobbers still report inability in obtaining sufficient stocks to meet their requirements, but there is a slightly better condition existing at the factories, so that better shipments may be hoped for in the future.

FLEXIBLE NON-METALLIC CONDUIT.—There has been an increase of approximately 20 per cent in prices as of the end of last week. The market outside of the city is reported good. The upward tendency of prices probably has been anticipated, for factories are working at good capacity. New orders require about two weeks to fill. The price tendency is reported still upward.

POLE-LINE HARDWARE.—Business is gradually picking up in better shape. Orders are growing bigger, although rather in anticipation of filling needs before prices advance than for any stocking purposes. Factories are making stocks for an anticipated demand.

FANS.—There is a fair volume of sales always going through, but nothing like the quantity sold during the hot spell four weeks ago. Stocks are in better shape now to meet another heavy demand, although the supply of 16-in. fans is behind in some places. Later calls are expected for residence work, when the smaller sizes will, without doubt, come to the front. Ceiling fans and low-voltage fans are finding an increasing sale. Garment factories in particular are using many of the ceiling fans, owing, it is said, to demands from the workers for more comfort, or the desire of owners to forstall possible labor uneasiness.

SCHEDULE MATERIAL.—Manufacturers' prices appear steady, but jobbers report considerable price cutting among the trade.

RANGES.—The electric range business, according to one manufacturer, is getting a little better in the outlying districts in the country estate field. One large department store is meeting with success in the sale of ranges.

WEATHERPROOF WIRE.—Larger sizes are selling in better volume for transmission work outside of New York City. A representative base is 23 cents.

MOTORS.—Early this month agency discounts on some motors eased up a bit. Certain fractional motors dropped off about 5 per cent in price, while one line of motors in general dropped from 5 to 10 per cent.

CHICAGO

The business outlook for the electrical industry in this section of the country is remarkably bright. Retail stocks are moving rapidly. Manufacturers' and jobbers' business is generally good. For the first time in about three years permits for buildings, residences, apartments, etc., in the city of Chicago are up to normal. Two hundred and forty-five building permits were issued last week, of which 205 were for residences and apartments. The money involved is about $4,000,000.

Industrial towns and cities in the Middle West are exerting every effort to overcome the housing shortage, realizing that the first to offer good homes will get the pick of the labor. With this end in view a number of manufacturers in Kenosha, Wis., organized a corporation to build at least 1000 homes this year. Grand Rapids, Mich., is attacking the problem in much the same manner. Nearly all the small industrial towns report a shortage of labor.

COPPER WIRE.—There is a growing demand for use in new buildings. Demand for transmission-line copper is being maintained. The price advanced on rubber-covered to a 24-cent base, although some is still selling at 22 cents. Weatherproof is around a 23-cent base.

CONDUIT.—The demand is spotty, with no change in price.

NON-METALLIC CONDUIT.—The price was increased 20 per cent last week. This is the second increase of about the same amount within a month.

SCHEDULE MATERIAL. — Sales are increasing, and prices are firm.

HOLLOW WARE.—Retailers are doing a big business and are able in most cases to get shipments from stock.

IRONS.—Stocks are getting low, and one manufacturer is about two weeks behind on deliveries.

RANGES.—Central-station stock, some of which was purchased before the war, has been largely disposed of, and new orders are being placed. The demand has grown so rapidly that one manufacturer is from thirty to forty-five days behind on shipments.

FANS.—The exceptionally warm weather for this time of year has increased fan sales to a point where stocks are uniformly low for all sizes. This does not mean that the manufacturers have accurately gaged the demand, but that the call for fans has been so insistent that buyers are willing to take what they can get if they can't have what they want. From present indications there will be few if any fans left over at the end of the season.

PORTABLES.—Manufacturers of wooden table portables and floor lamps in this section of the country are from three to four months oversold, due principally to lack of skilled help, which is mostly foreign-born. The limited supply of wooden lamps has increased the demand for metal portables to some extent. Retailers are experiencing difficulty in getting silk shades.

TRANSFORMERS.—There is a heavy demand for small distribution transformers up to 5 kva. for primary pressures up to 13,200 volts.

TRACTORS.—One manufacturer is able to make deliveries of three-wheel and four-wheel industrial electric tractors from stock. Sales for export to Europe are increasing more rapidly than domestic business.

POLES.—Last week the price of Northern white cedar poles advanced 10 to 20 per cent, depending upon the size. Stocks are getting low considering the present demand.

BOSTON

Trade is rather streaky this week, with uneven distribution of business in different parts of New England. An enormous demand for socket appliances is noted and a good deal of repair and minor reconstruction work is under way. In the Connecticut Valley building operations continue on a substantial scale. A fair amount of central-station line construction is in progress in northern New England. The demand for industrial material, on the other hand, is quieter this week. Engineers are doing a lot of proposition work, but large commitments along industrial lines are retarded by the disposition to await lower prices.

The feeling is general throughout the electrical trade that lower prices are a long way off and that it is a waste of time to hold back necessary construction because of present price levels. Wire prices tend upward, but other material shows little change either way. Deliveries are for the most part good, though the demand for washing machines and cleaners in this section is beginning to tax the factories heavily. Collections are good at present. Labor is much disturbed in the brass-manufacturing district of Connecticut and electric railway strikes are adding to the burdens of industrial life in the northern Massachusetts district. Jobbers' stocks are in very good shape with a few exceptions, such as metallic flexible conduit and some makes of vacuum cleaners.

FANS.—The demand is steady and retail stocks are somewhat low. The trade is particularly strong in 10, 12 and 16-in. oscillating outfits. The 8-in. non-oscillating fans are also moving well. Six-blade fans are not selling as well as last year.

WIRE.—Bare wire is up a cent to 21 cents base and weatherproof and rubber-covered wire are quoted on 23 cents base, also an advance over last week. Flexible armored conductor is scarce.

FARM-LIGHTING SETS. — Business is brisk and the foundations are now laid for a big fall business. The demand has reached a point where some care has to be taken to maintain local stocks for immediate delivery. On very large units the deliveries are much improved and one representative maker guarantees shipment in thirty days, and even in two weeks on rush orders, compared with former shipments of from sixty to ninety days. The demand from summer cottagers is healthy.

WASHING MACHINES.—Carload shipments into New England are the order of the day, and the market grows like a rolling snowball. Washers cannot in some cases be supplied fast enough to suit distributers.

VACUUM CLEANERS.—Trade is very active. Factories are hard pressed to meet the demand, and some agencies have all that they can do to make deliveries promptly enough to suit the market.

ELECTRIC TABLEWARE.—June will show an excellent business in these outfits. Sales for gift purposes have been unusually active.

STORAGE BATTERIES.—A temporary lull in the demand for automobile batteries appears to be the feature of this week's trade. The electric vehicle market is quiet for the moment.

INDUSTRIAL ELECTRIC TRUCKS. — The market is quieter than for some time. Underlying conditions, however, are sound.

PORTABLE LAMPS.—Sales are progressing well. Money is being expended plentifully in beautifying summer homes, and this means a steady demand for artistic portables.

WIRING MATERIAL.—Stocks are ample to meet current demands. The consumption of this material is still below expectations, but will respond immediately after building operations get started on a large scale.

ATLANTA

Business in nearly all lines is intensely active. Jobbers report a larger volume of sales than recorded for the same period a year ago, when purchases for government account had reached their height. Collections are good. The Allied Packers' Company, Savannah, Ga., has been incorporated for $25,000,000 and will proceed with construction immediately.

CONDUIT.—Black and white rigid are moving fast, keeping pace with industrial requirements and apartment construction. Prices remain steady; stocks are normal and incoming shipments are averaging two weeks.

PANELBOARDS.—This item is picking up rapidly as building advances. The volume of business is considerably in excess of that during May. There has been no material change in prices since last August.

CONDUIT FITTINGS.—Prices are steady with the exception of connectors, which have declined approximately 15 per cent. Business is active and stocks are in good shape.

ARMORED STEEL CABLE.—The market has been stimulated by textile lighting and apartment house demand. Prices have increased gradually about 10 per cent during the last few months. Stocks are lower this week.

STAMPED-STEEL BOXES.—Coincident with a growing demand for conduit products and wiring materials, this item has experienced a brisk trade. Local stocks are in fair condition. Eastern shipments are prompt.

PRINTING-PRESS MOTORS.—The demand for this equipment is growing and activity was further accelerated this week. Manufacturers are looking forward to a substantial future business. Prompt deliveries are being made from central points.

FLEXIBLE STEEL CONDUIT.—There is very little call. Stocks are well filled.

SMALL SWITCHBOARDS.—The demand from apartment-house, small building and theater construction has stimulated the market, and a satisfactory volume of business is being transacted. Prices are steady and shipments are ranging from four weeks on the standard to two months on the more elaborate boards.

FIXTURES.—Jobbers and dealers report a heavy demand which they have difficulty in filling. Deliveries are slowing up to an average of eight weeks. Prices have advanced about 12 per cent this week.

GLASSWARE.—Requirements are increasing steadily. Factory shipments are uncertain, owing to labor troubles, and it is rumored that prices will be higher shortly.

FANS.—A shortage of direct-current fans exists. Especially is this true of Atlanta, but as the season is rapidly advancing dealers are not making any effort to fill in. The return of normal weather conditions is evidenced by a brisk movement this week of all alternating-current types. Oscillating fans are becoming more popular than the non-oscillating type. Stocks are ample.

BELL RINGING TRANSFORMERS.—Residence construction has accelerated the demand and a big volume of business is being done. Deliveries are prompt and prices firm.

FLASHLIGHTS.—The market is lifeless, compared with previous months. Stocks are accumulating.

SEATTLE—PORTLAND

Jobbers in Seattle report that with the exception of an increasing movement of domestic appliances sales are still running light. This condition is particularly true in connection with shipyards, lumber mills and industrial plants. Sales to shipyards last week showed further decreases. In preparing for the day when government construction shall end, the Skinner & Eddy Corporation, Seattle, has placed an order for sufficient steel to build four 10,000-ton cargo carriers, to be built as soon as the contract ships are completed. It is believed probable that other steel yards may follow this lead. Reports from all over the Northwest show wood yards nearing the end of their program and plants will shut down unless foreign contracts are received.

Realty men report the demand for vacant lots increasing weekly. The demand for houses shows no decline.

An ordinance providing for constructing a 10,000-kw. unit addition to Seattle's municipal hydroelectric power plant is in Council, and no doubt exists that the bill will pass. A new unit costing $280,000 and transmission line to cost $150,000 are proposed. The ordinance providing for a penstock to cost $195,00 has passed. The proposition of issuing bonds in the sum of $300,000 for the purchase of the Lake Cushman power site will be submitted to voters in Tacoma.

Portland territory reports business in small motors and equipment good. The Tutler Manufacturing Company recently placed an order for fifty ¼-hp. and ½-hp. motors for apple graders. The Pacific Power & Light Company purchased a 2000-kw. Curtis turbine-driven alternator for its plant at Astoria. The Crown Williamette Pulp & Paper Company placed an order for three additional 350-hp. Jordan motors for its paper plant at Camas, Wash.

COPPER WIRE.—Seattle jobbers report better sales, particularly in smaller sizes. A slight advance along all lines became effective June 23. Stocks are in good condition.

WASHING MACHINES.—Demand is still on the increase and deliveries are well maintained. During the week several dealers in rural districts reported increasing sales. Stocks are well filled.

DOMESTIC APPLIANCES.—Further increases in sales were reported by retailers during the week. Gradually the electric dishwashing field is being opened up and excellent results are being obtained. Dishwashers in this region are comparatively new, but from present indications no trouble will be encountered in moving stocks.

FIXTURES. — Retailers specializing in fixtures report conditions betwixt and between. Sales of higher-class merchandise compare favorably with the movement of cheaper grades. Business has boomed owing to the enormous amount of residence construction. Shipments from the East are coming through well. There has been no decrease in prices.

SAN FRANCISCO

Business is excellent, with many new wiring jobs reported. After many months of counter and house-to-house sales, dealers find that they can again work their contracting force.

A strike of the telephone operators and linemen of the lines of the Pacific Telephone & Telegraph Company has interfered with service to some extent. Unless there is an early termination of the strke, the electrical workers of the state intend to strike in sympathy.

LAMPS.—Because of competition and the signing up of new agents there is very little let-down in demand. The Pacific Coast factory of the National Lamp Works will close for the annual two weeks' shut-down early in July. The new 50-watt C-4 Mazda lamp, listing at 65 cents, is now ready for delivery, and it is gratifying to note that a safe stock was accumulated for delivery before the actual announcement was made.

RADIATORS.—Spring and early summer radiator sales have been hurt by unusually fine weather conditions, and contractors are loaded up. The suit instituted by the Majestic Electrical Development Company against the Hotpoint Division has been decided in favor of the former.

FARM-LIGHTING PLANTS.—The demand is excellent, but because of strikes and other factory troubles deliveries have been rather poor.

INSULATING MATERIAL.—Prices have remained fairly constant, and local stocks are good, but the demand is nowhere near what it was last year. This is principally because conditions do not call for motors as they did last year, and also because a far larger proportion of new motors on invoices are being received, thus lessening the need for returning patched-up motors to the firing line.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

Armored Conductor, Flexible Steel

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	5%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Twin-Conductor

No. 14 Solid	
Less than coil	$100.00
Coil to 1000 ft	82.50
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Attachment Plugs

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	23% to 36%

Batteries, Dry

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

Batteries, Dry—*Continued*

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

Conduit, Metallic Flexible

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

Conduit, Non-Metallic Flexible

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
1	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$20.75	$21.50
½-in.—	30.00	21.50	20.50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
⅜-in.—	$33.00	$17.50	$16.25
½-in.—	36.00	19.00	17.25

Conduit, Couplings and Elbows, Rigid Iron

Card No. 40

Size, In.	Conduit, List per Foot
⅜	$0.08½
½	.08½
¾	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

Conduit, Couplings and Elbows, Rigid Iron—*Continued*

Size, In.	Couplings, List	Elbows, List
⅜	$0.05	$0.19
½	.06	.19
¾	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	⅜ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅜ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3% to 6.1%	2% to 8.1%
2500 to 5000 lb.	+1% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

Flatirons

NEW YORK

List price	$6.50 to $7.50
Discount	25%

CHICAGO

List price	$6.50 to $7.50
Discount	25% to 30%

Fuses, Inclosed

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

Fuse Plugs

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

Lamps, Mazda or Tungsten

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

Lamp Cord

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$26.47–$35.01
Coil to 1000 ft.	23.82– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft.	21.00

Lamp Guards, Wire

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

Outlet Boxes

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	33%–40%	24%–32%
$10.00 to $50.00 list	45%–50%	32%–43%

Pipe Fittings

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

Porcelain Cleats—Unglazed

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $22.40
1/5 to std. pkg.	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$17.85–$24.15
1/5 to std. pkg.	14.70– 21.00

Standard pkg., 2200. List per 1000, $20.00 to 21.00

Porcelain Knobs

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg.	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg.	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg.	11.20– 16.00	22.40– 32.00

Sockets and Receptacles

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20 to list
1/5 std. pkg.	List to 10%

Switches, Knife

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

Switches, Snap and Flush

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

Switches, Snap and Flush—*Continued*

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	23%

Switch Boxes, Sectional Conduit

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 50%

Toasters, Upright

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	25% to 30%

Wire, Annunciator

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.42
No. 18, full spools	.35– .40

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46 to $0.56
No. 18, full spools	.41 to .51

Wire, Rubber-Covered, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	18.90	18.90	14.18
10	25.50	25.50	17.00
8	34.94	29.10	23.28
6	55.38	46.15	36.92

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.50	$10.00–$11.00	$9.50–$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.9	34.62	24.62
6	63.84	54.72	54.72

Wire, Weatherproof

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$27.00–$29.25
25 to 50 lb.	27.00– 25.25
50 to 100 lb.	26.00– 23.25

CHICAGO

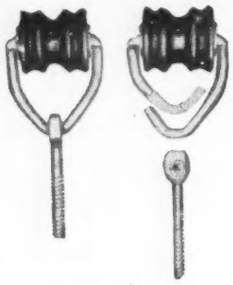
	Per 100 Lb. Net
Less than 25 lb.	$25.75 to $26.50
25 to 50 lb.	25.75 to 26.50
50 to 100 lb.	25.75 to 26.50

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Easily Installed Wiring Bracket

In order to make the installation of its "Holdem E-Z" type brackets more convenient, the B. & K. Manufacturing

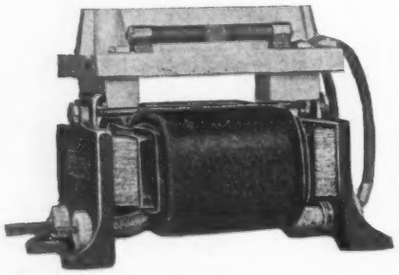


BRACKET SHOWN ASSEMBLED AND SEPARATED FOR INSTALLATION

Company of New Britain, Conn., has made the screw part of the bracket separable from the insulator and its holder, as can be seen in the illustration. This construction makes it possible to insert the screw in the wall first and then attach the rest of the bracket, an improvement over the customary manner of holding the entire bracket and screwing it into the wall.

Dry-Insulated Potential Transformers

For use in conjunction with alternating-current instruments and meters where a high degree of accuracy is desired the Condit Electrical Manufacturing Company of South Boston, Mass., has developed type W potential transformers with a maximum voltage of 5500, 25 or 60 cycles. They have a ratio such that at normal rated primary pressure the secondary pressure is 110



EQUIPPED WITH CUT-OUT BASE AND FUSES

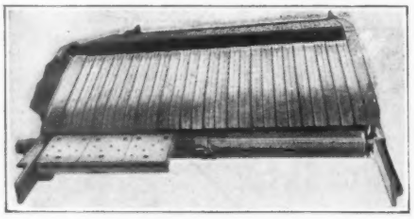
volts. The temperature limits specified by the A. I. E. E. are said not to be exceeded even though these transformers are operated continuously at 10 per cent above their normal rated pressure and at their rated volt-ampere capacity.

A high factor of insulation has been provided, it is pointed out, the transformers being dry-insulated and thoroughly impregnated. One primary and one secondary lead, properly marked to indicate the polarity, are provided. The windings are so related that the instantaneous ingoing current of the marked high-voltage or primary lead corresponds to the outgoing current of the marked low-voltage or secondary lead.

For pressures of 2500 volts or less a cut-out base may be obtained as an integral part of the transformer. On pressures in excess of 2500 volts the fuse base must be separately mounted. The construction of these transformers allows them to be installed in a minimum of space.

Square-Bar Dump

In its type "E" stokers the Combustion Engineering Corporation of 11 Broadway, New York City, has incorporated an improved dumping ar-



SQUARE BARS USED INSTEAD OF ROUND ONES

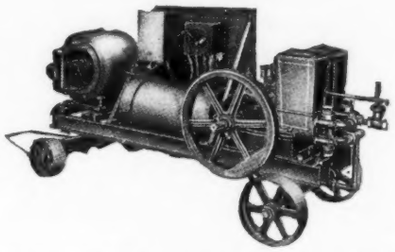
rangement which is declared to be superior to the trunnion design. Square bars instead of round ones are employed and make for greater ease in handling the dumps for cleaning the fires.

Portable Electrically Driven Air Compressor

In shipbuilding, subway construction, mining operations, or where conditions are such that gasoline or kerosene may not be used, or wherever electric power is available, the portable electrically driven air compressor marketed by Chris D. Schramm & Son, Inc., Philadelphia, is said to be particularly useful.

The electric motor and the compressor are mounted on a truck, the weight being properly distributed so that the unit can be easily moved around. A pliable and wide weatherproof belt is used to connect the motor and the compressor.

The compressor used in this outfit is a double-cylinder, single-acting type, which does not take up much space. A further advantage is that the water-hopper cooling feature entirely elimi-



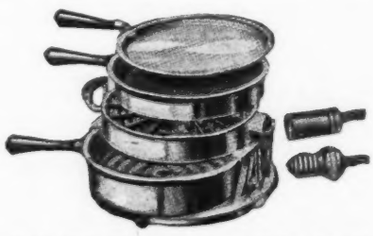
WATER-HOPPER COOLING FEATURE ELIMINATES PIPE CONNECTION

nates the pipe connection for inlet water or outlet water. An automatic unloader, a complete oiling system, a belt pulley and flywheels are furnished with the compressor.

Electric Grill for Frying, Boiling, Baking and Broiling

Baking, boiling, broiling or frying can be performed on the electric grill which Manning, Bowman & Company of Meriden, Conn., are marketing for use in light housekeeping and for cooking meals directly on the dining table. As one pan fits under the heating coils and another above it, two things may be cooked at once.

The grill is rated at 550 watts, but gives a low and medium heat of 137 and 275 watts in addition to the full heat. Three cooking pans with diameters of 8⅛ in. (206 mm.), and depths of 2, 1½ and ⅝ in. (50, 38 and 9.5 mm.) are supplied, the deepest pan having a grid



HAS LOW, MEDIUM AND HIGH HEATS

for broiling, toasting and kindred culinary operations. The grill is nickel-plated and equipped with a detachable plug, 6 ft. (2 m.) of cord and lamp-socket connections.

Light-Weight Portable Electric Drill

A motor-driven portable drill which can be used on hard wood up to $\frac{5}{16}$ in. (7.9 mm.) and on metal up to $\frac{1}{4}$ in. (6.3 mm.) has recently been brought out by the Stow Manufacturing Company of Binghamton, N. Y. Lightness is one of its features, the maker points

LIGHT IN WEIGHT; CAN BE USED ON BOTH METAL AND WOOD

out, since the weight of the drill including chuck is but 6 lb. (2.7 kg.). The over-all length of the tool is 11 in. (27 cm.).

The universal motor with which the drill is equipped has a maximum horsepower of $\frac{1}{3}$, a loaded-spindle speed of 1000 r.p.m., and is wound for either 110 volts or 220 volts alternating current, single-phase.

Motor-Driven Window Advertising Machine

The "Symetriscope," a motor-driven advertising display device for use in store windows, etc., which is now being marketed by J. B. Beans, 1216 Land Title Building, Philadelphia, consists of a rotating chamber formed of a series of triangular mirrors so arranged that they present to the eye all the effects of a kaleidoscope. It differs, however, from the kaleidoscope in that a score of persons can see the changing figures at the same time, and, in place of transparent objects or bits of stained glass, opaque objects of any kind can be used —artificial flowers, ribbons, banknotes, etc.—all of which can readily be changed.

The device contains 22 ft. (6.7 m.) of advertising space. This space is divided into ten independent sheets which appear successively from the same roller, all being readily changed for others. While the sheets appear the attraction—that is, the rotating mirrors —disappear, thus leaving nothing to detract the spectators' attention from the advertisement.

The device can readily be changed into a machine of different appearance. It is so constructed that nine cardboard disks can be placed in a circle around the chamber in which the figures are displayed, all turning with the chamber and maintaining an upright position, so that any lettering thereon can at all times be read with ease by the passer-by.

Ampere-Hour Meter for Storage-Battery Applications

Especially designed to meet the severe overload and vibration requirements of mine locomotives, industrial tractors and storage-battery trucks, a locomotive-type ampere-hour meter has been placed on the market by the Sangamo Electric Company of Springfield, Ill. This meter registers the ampere-hours which the battery discharges in driving the vehicle. When the battery is put on charge the meter registers as the charge proceeds, and when the battery has been fully charged zero is registered and contact is made within the meter, tripping a circuit breaker in the charging circuit.

Giving the battery a certain amount of excess charge each time it is charged has been provided for in the locomotive-type ampere-hour meter by a variable resistor device which causes the meter to run slower by any desired percentage on charge than on discharge for equal current flow. It automatically provides that the battery will be given any desired percentage of overcharge, for by the time the meter indicating hand gets back to the full charge position all of the previous discharge plus certain percentage overcharge, depending upon the setting of the variable resistor elements, will have been put back into the storage battery.

Heavy-Duty Oil Engines for Station or Marine Service

In designing its heavy oil engines for station and marine use the Pittsburgh Filter & Engineering Company, Pittsburgh, Pa., has aimed to combine accessibility with the simplicity of the Hvid type engine, a strong effort being made to minimize attention on the part of the engineer in charge. Furthermore, the parts of these engines are interchangeable so that if repairs are necessary new parts of perfect fit can be obtained.

The engine is of the inclosed type, cam-shaft bearings, roller levers and gears being inclosed as well as the crank case. These parts run in an oil bath, yet the cam shaft can be removed merely by taking off the front cover. The crank pins are accessible through large openings in the crank case. Slotted mufflers admit air to the cylinders.

Means of starting is provided by compressed air supplied to each cylinder through an air-starting valve. Compression relief valves are also provided to assist in starting. The start and the relief valve rockers are mounted upon eccentric shafts so that by a single turn of the control gear the engine is brought from the starting to the running position, and this control lever also shuts off fuel to the cylinders during the starting period. A compressor driven by the engine shaft provides compressed air for the starting tanks.

The fuel supply is regulated by a governor mounted upon a vertical shaft. Besides this automatic regulation, which provides constant speed, a hand control lever regulates the speed while running. The lubricating system is automatic. Two grades of lubricant are used, one for the pistons and the other for bearings. Lubrication of the pistons is accomplished by a Richardson-Phoenix force-feed oiler driven by the cam-shaft. Individual feeds are used in this lubricator as well as a float valve for keeping the lubricator filled from an overhead oil reservoir.

The crank shaft of open-hearth steel is forged from the solid billet, and in the smaller sizes of the engines up to the four-cylinder sizes it is forged in one piece. Since no cross-heads or guides are employed, the piston is made of the trunk type and sufficiently long to insure long wear. The inside of the top of the piston is equipped with ribs providing with radiation of heat as well as increasing strength. The cylinder head is of high-grade gray cast iron, efficiently water-cooled.

Individual Beverage Heater

Liquid weighing 8 oz. (236 ml.) may be individually heated in one minute through using the "Thermovac" electric beverage heater which is being made by the H. B. Gibson Company, 123 Liberty Street, New York City. The resistance heating element of this heater is in the form of a nickel chromium built-in coil. The inner receptacle is surrounded by a vacuum chamber so

HEAT INTENSIFIED BY VACUUM CHAMBER SURROUNDING HEATING COMPARTMENT

that the heat is forced directly into the heating compartment.

Both the outside and inner wall of the heater are spun from one-piece heavy plate copper. The inside wall of the vacuum chamber is covered with "Thermoval" insulation, while the outer wall of the chamber has an inner covering of "Thermo" heat and cold resistance lining. The intensified heat radiator which is surrounded by the heating coil is made for four separately "cured" sections.

This heater can be placed underneath any electric drink mixer having an overhead motor and the drink may be mixed directly after it has been heated;

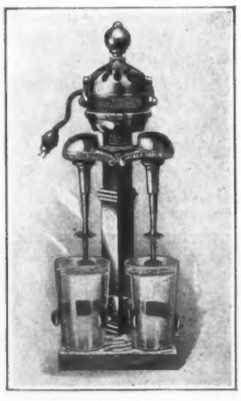
a detachable plug is attached to the heater's handle and lamp socket connections are provided.

Storage-Battery Locomotives for Industrial Service

Rugged construction, simplicity of operation and ease in maintenance are pointed out as features of the storage-battery locomotives which have been developed by the Ironton Engine Company of Ironton, Ohio, for industrial haulage. Three types are made: Type "K" is intended for shifting heavy cars and for general yard work; type "L" is designed for general light haulage work, and type "J" can be used for plant and intershop haulage. The first two styles are equipped with inclosed cabs for the engineer, while the third style has none but can carry a load on its deck.

Double Electric Drink Mixer

Two drinks can be mixed at the same time with the "twin mixer" which is being placed on the market by the H.



BOTH AGITATORS OPERATED BY ONE MOTOR, TOGETHER OR INDEPENDENTLY

B. Gibson Company, 123 Liberty Street, New York City. One Hamilton-Beach electric motor is used to operate both agitators, they being operated together or separately. A velocity of 8000 r.p.m. is obtained in the mixer, which uses no gears.

Radiation-Cooled Ventilating Fan Motor

The "Autovent" fan motors now being marketed by the Batterman-Truitt Company, 736 West Monroe Street, Chicago, are radiation-cooled and dispense entirely, the maker says, with the necessity for cooling by exposure or by passing air through the motor. Through cooling by simple radiation the motor is said to be protected against the entrance of contaminating substances contained in the air discharged from the ventilating fan.

At the fan end of the motor there is normally a considerable neutral air space created by the interference of the motor itself with the current of air passing through the fan wheel. On the Autovent fan wheel there is a special device, the centripetal vanes, at the axis of the fan wheel, which causes the inner air currents nearest the motor to converge closely around the motor at the fan end and also increases the velocity of these air currents through the fan wheel at the axis. This convergence of inner air current greatly diminishes the size of the neutral air space and brings these air currents into such position as to create an ideal means for taking up and carrying away the heat radiated from the fan end of the motor. Because the converging air currents keep the smaller neutral air space constantly cooler than the interior of the motor the heat generated in the windings of the motor radiates immediately through the apertures into this cooler neutral space and comes into immediate contact with the swiftly moving walls of air currents and being instantly carried away with the general exhaust.

The front end of the fan motor, or the end opposite the fan wheel and standing against the air currents, is securely closed up, with covers removable for inspection. Since there is no current of air entering or passing through the motor there is no means for the conveyance therein of contaminating, corroding or depositing substances.

Notes on Recent Appliances

Farm-Lighting Set

The "Reeco" low-speed electric lighting plant has been placed on the market by the Rural Electric Equipment Company of Canton, Pa.

Electric-Steam Vulcanizer

An electrically heated steam vulcanizer has been placed on the market by James C. Heintz & Company, 2069 East Ninth Street, Cleveland, Ohio.

Portable Reading Lamp

A spun-brass, white-enameled and hand-decorated portable electric reading lamp with a figured silk shade is marketed by William R. Noe & Sons, 53 West Twenty-first Street, New York City.

Turbo-Generator for Car-Lighting Service

A 500-watt, 32-volt turbo-generator for car lighting is being marketed by the Gould Coupler Company, 30 East Forty-second Street, New York City.

Cord Coiler for Electric Irons

The Haynes Manufacturing Company, Salt Lake City, Utah, has placed on the market a cord coiler for obviating the tendency of an electric iron to get in the user's way.

Dry Cells for Ignition and Flashlight Use

A complete line of dry batteries, comprising the regular No. 6 1½-volt igniter and telephone types and eight sizes for flashlight use, has been developed by the Delta Electric Company of Marion, Ind.

Portable Direct-Current Instruments

The Roller-Smith Company, 233 Broadway, New York City, has improved its "Handy" type portable direct-current instruments, which are offered in such combinations as ammeters, milliammeters, voltmeters. millivoltmeters and voltammeters.

Generator Set

The Anderson Engine Company, 3046 North Rockwell Street, Chicago, has developed an electric generator set driven by a gasoline engine.

Miner's Type and Tubular Flashlights

Miners' type and tubular flashlights are included in the line of flashlights which the Delta Electric Company of Marion, Ind. is placing on the market.

Underslung-Battery Industrial Trucks

Electrically driven industrial trucks with underslung batteries are made by the Cowan Truck Company of Holyoke, Mass.

Motor-Driven Clothes Washer

The Sandusky Washer Company of Sandusky, Ohio, has placed on the market an improved type of electrically operated clothes-washing machine.

Mechanical Overload Release

Frank E. Aurand, 123 South Cuyler Avenue, Oak Park, Ill., has developed the "Lettgo" mechanical overload release, which is a device for automatically disengaging the driving power from driven machinery should the load exceed a predetermined amount.

Vibration Meter and Electro-Tachometer

The electro-tachometer referred to on page 817 of the ELECTRICAL WORLD of April 19, 1919, was designed and invented by K. G. Frank, president of the American Precision Works, and H. Sticht, who have applied for a patent on the device. The vibration meter described on page 765 of the ELECTRICAL WORLD of April 12 was also designed by K. G. Frank, and both instruments are manufactured by the American Precision Works, 135 Cedar Street, New York City.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Italy (No. 29,625) wishes to secure an agency for the sale of electrical goods. Correspondence may be in English.

A person in Spain (No. 29,626) desires to secure an agency for electric lamps. Correspondence may be in English.

The purchasing agent (No. 29,711) of a firm having large department stores in several different countries is in the United States and wishes to purchase for immediate delivery, among other things, electrical goods, etc. Payment cash, or terms suitable to seller.

The purchase by a company in India (No. 29,687) of electrical industry supplies, gas and electric fixtures, iron, steel boilers, electrical cable-making machinery, porcelain insulators, and porcelain articles used in electrical industries is desired. Terms, cash against documents.

A firm in Brazil (No. 29,682) desires to purchase electrical materials of all kinds, such as wire cables, insulators, sockets, globes, plugs, fuses, switches and interrupters. A list and description of the supplies required was forwarded and may be examined at the bureau or its district offices. (Refer to file No. 117,955). Correspondence should be in Portuguese.

K. F. van den Bergh, trade commissioner from the Dutch East Indies to the United States, has stated that a special demand exists in his native country for electrical appliances.

Armas Saastamoinen, the new Finnish Minister to the United States, says that "recognition of the independence of Finland by the United States and Great Britain would be a great stimulus to business. We are in America for every kind of raw materials and manufactures, notably iron and steel, oil and electrical machinery. We prefer to deal directly with Americans and not through intermediaries. In return there are wonderful possibilities in Finland for American buyers."

Francis Furnier, member of the French Republic Committee, has come to New York to arrange for the purchase of large quantities of commodities most needed by France. He is here with the sanction of the French government. Electrical motors are among the articles he expects to purchase. Samples will be sent to the prospective buyers in France and after the selection is made payment will be arranged by the Crédit Lyonnais and the National City Bank of New York.

JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., electrical supply jobbers, have begun the practice of issuing a monthly price book. The second issue, dated June, is now out.

A RENNERFELT electric furnace of 300 lb. capacity and 60 kva. has been sold by Hamilton & Hansell, Inc., New York, to the General Chemical Company, to be installed at its plant at Laurel Hill, Long Island.

THE BORDEN COMPANY, Warren, Ohio, announces that Charles A. Greene, Chicago representative for the Borden Company, manufacturer of "Beaver" pipe tools, has opened a downtown office at 549 West Washington Boulevard, Chicago.

THE HOOVER SUCTION SWEEPER COMPANY, North Canton, Ohio, will establish its Canadian headquarters in Hamilton, Ont., where it will erect a plant. Heretofore it has had a small plant at Windsor, Ont., but this will be moved to Hamilton, where temporary offices at 20 Macnab Street South have been secured.

THE FLEXLUME SIGN COMPANY, Buffalo, N. Y., announces that Albert Dodge of Buffalo has been elected secretary and treasurer to take the place of the late W. S. Wright. Its Canadian office and factory has been moved from St. Catharines, Ont., to Toronto, where it is located at 92-94 Adelaide Street, East. Its volume of business this year has compelled the company to enlarge greatly its floor space and to make radical changes in its office force and office location.

THE OHIO ELECTRIC & CONTROLLER COMPANY, 5800 Maurice Avenue, Cleveland, Ohio, has placed a contract for a two-story plant, 80 ft. by 100 ft.

THE EDISON ELECTRIC APPLIANCE COMPANY, INC., Chicago, has asked for bids on the structural steel for a 340-ft. by 350-ft. addition to its plant at 5660 West Taylor Street.

H. L. GARBUTT, formerly manager of the line-material section of the supply department of the Westinghouse Electric & Manufacturing Company, has recently been made local supply manager of that company at San Francisco, Cal.

THE CHINA ELECTRICITY COMPANY is a new concern being organized by the Sino-Japanese Industrial Company and the China Industrial Development Association to combine the Japanese branches in China dealing in electrical goods.

C. McKEW PARR, general sales manager for the Hart & Hegeman Manufacturing Company, Hartford, Conn., has returned after about a year and a half in the service. He was connected with the bureau of exports of the War Trade Board

C. M. PARR

at Washington. Later he was sent as special representative of the War Trade Board with a commission as special assistant of the Department of State, also being appointed vice consul at Las Palmas, Canary Islands, and at Barcelona, Spain. He also had missions in France and England.

RATHBONE, SARD & COMPANY, stove and range manufacturers, have recently opened branch offices in San Francisco, Portland, Los Angeles and Salt Lake City. The company is starting a vigorous selling campaign to increase its sales of electric ranges, especially in the coast and mountain states where low energy rates prevail. The organization in the West is directed by C. F. Jaques, district sales manager, with headquarters at the Portland branch. The San Francisco branch is in charge of M. S. Barnett, the Los Angeles branch of M. M. Merritt, and the Salt Lake City branch of M. C. Bennett.

WILLIAM B. SCAIFE & SONS COMPANY, of Pittsburgh, Pa., announce the opening on July 1 of a Chicago sales and engineering office, at 38 South Dearborn Street, with Charles F. O'Hagan, formerly chief engineer of the company at Pittsburgh, as resident engineer and manager. This company is one of the oldest manufacturing concerns west of the Allegheny Mountains. During the more than 100 years since its business was founded, it has from time to time, as conditions arose, added to its manufacturing facilities. It now manufactures black or galvanized, riveted, brazed or welded steel tanks for air, gas and liquids, steel shipping drums, range boilers, steel structures, and also the "We-Fu-Go" and Scaife water softeners and filtering equipment.

THE TRIUMPH ELECTRIC COMPANY, Canfield, Ohio, has placed a contract for a one-story plant, 60 ft. by 80 ft.

THE DAVIS STORAGE BATTERY COMPANY, Lynn, Mass., has decided to enlarge its plant from 20,000 sq.ft. to 50,000 sq.ft. of floor space.

THE PACIFIC STATES ELECTRIC COMPANY, San Francisco, Cal., announces the creation of a sales promotion and advertising department in charge of M. T. Dolman.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., announces the opening of its new office at 505 Fifth Avenue, New York City, under the management of A. F. Wilson.

THE ALLMUR MANUFACTURING COMPANY, Marion, Ind., announces that it has just received an order from the Mexican government for two carloads of automatic electric cooking stoves for use in the government institutions in Mexico City.

THE DOEHLER DIE-CASTING COMPANY, Brooklyn, N. Y., announces the organization of employees of the company under the name Doehler Die-Casting Employees' Association. The initial issue of "Doehler's Topics" for June, 1919, has just been published.

THE JAMES LEFFEL COMPANY, Springfield, Ohio, maker of turbine waterwheels, whose present plant was sold to the Robbins & Myers Company, is having plans prepared for enlarging and fitting up the plant of the Columbia Planer Company, which it has acquired. Its present capacity will be more than doubled.

THE CLEVELAND ELECTRIC MOTOR COMPANY, Cleveland, Ohio, announces that it has recently moved into larger quarters and is now in a position to expand on its line of polyphase induction motors. The local success of its product having been established, the company is in a position to distribute it throughout the country.

THE COOPER HEWITT ELECTRIC COMPANY, Hoboken, N. J., announces that it has recently opened a district sales office in the Majestic Building, Milwaukee, Wis., in charge of H. T. Braschler, district sales manager, and also a district sales office at University Building, Syracuse, N. Y., in charge of George D. Senior, district sales manager.

THE DIEHL MANUFACTURING COMPANY, Elizabeth, N. J., announces the removal of its Boston office from 201 Devonshire Street to 566 Atlantic Avenue, at which address the storeroom and service department will be located. In Chicago the company's branch is at 1017 West Jackson Boulevard, with a stock of motors and parts ready for immediate delivery to customers.

J. LIVINGSTON & COMPANY, INC., constructing engineers, 104 East Eighty-first Street, New York City, who for the past twenty years have devoted practically their entire time to electrical construction and engineering, have recently entered the electrical appliance field. Display rooms have been opened at 104 East Forty-first Street, where are shown electrical labor-saving appliances for the household. The company is metropolitan district distributer for the "Easy" vacuum electric washer.

THE UNITED ENGINE COMPANY'S LINE, heretofore sold in the Northwest by the Waterbury Implement Company of Minneapolis, is now being sold direct to dealers through the company's new branch house at 22 North First Street, Minneapolis, under the management of Charles Bishop, who for more than twenty years was connected with the International Harvester Company. The company's electrical school for dealers is well under way. In this school dealers are instructed in the workings of farm-lighting plants, how to install and sell them. A new instruction and guide book is under way.

LEONARD F. FULLER has resigned as chief electrical engineer of the Federal Telegraph Company to become assistant manager of the Ohio Insulator Company, with headquarters at Barberton, Ohio. Mr. Fuller has been connected with the Federal Telegraph Company during the years in which the Poulsen arc has taken a leading place in long-range radio communication, and much of the improvement in recent years which has made these high-power sets a success is credited to him. He recently received the degree of Ph. D. from Stanford University for his original work in magnetic circuits as used in arc generators.

MAJOR GILBERT H. CRAWFORD of the 302nd Engineers has returned from France to the De La Vergne Machine Company, New York City, as assistant chief engineer of the ice machine department.

K. P. ROYCE, formerly a lieutenant in the Sixth Field Signal Battalion, U. S. A., is Detroit sales representative of the Burke Electric Company. Before entering the army Mr. Royce was assistant sales manager in the local office at Erie, Pa.

THE MUNICIPAL COUNCIL, Roberval, Que., will make repairs to its hydro-electric plant at a cost of $20,000, and is in the market for one 300-hp. horizontal-shaft turbine, head 50 ft., 600 r.p.m.; also one 250-kva. alternating-current generator and switchboard. J. F. Trenton, Chicoutimi, Que., is the engineer.

THE WARD LEONARD ELECTRIC COMPANY, Mount Vernon, N. Y., has recently issued a folder entitled "The Twenty-Year Club." Portraits of the founders, H. Ward Leonard and J. L. Kebler (now deceased), are shown on the cover, while inside are those of seven members of the company who have completed twenty years' service.

THE DELTA ELECTRIC COMPANY of Marion, Ind., has brought out a line of "Giant" batteries comprising the regular No. 6 1½-volt igniter and telephone type and eight sizes for all types of flashlight cases. A complete new line of flashlights has also been developed. A special factory is devoted exclusively to the manufacture of the new line.

THE FLETCHER ELECTRIC COMPANY, 15 West Seventeenth Street, New York City, has taken up the manufacture of annunciator and magnet wires of all sizes in silk, cotton and enamel. The trade name is to be "Flecto." All arrangements have been made for raw materials, and deliveries are expected to begin in two or three weeks. Complete stocks will be kept for the general trade.

A. M. PAPASIDERIS & COMPANY, 197 Hermes Street, Athens, Greece, announce that they are general importers and commission agents trading in industrial products, electrical machinery and supplies. They act as agents of various manufactures, taking up the exclusive sale of these products upon a stock basis or upon a commission basis. It is their desire to assist in introducing more American products into Greece.

THE INTERNATIONAL OXYGEN COMPANY, Newark, N. J., announces the appointment of Preston Belvin as assistant sales manager in charge of the Pittsburgh district sales work, with offices at 1319 First National Bank Building, Pittsburgh, Pa. The Chicago offices, in charge of Philip G. Wesley, have been removed from 223 Railway Exchange Building, to 817-20 Chicago Stock Exchange Building at 30 North LaSalle Street.

AKERLUND & SEMMES, INC., New York City, announce that they have recently brought into operation a 500-hp. producer plant for the Maritime Electric Company, Charlottetown, Prince Edward Island, Canada. This plant is for municipal electric lighting purposes and is operating on bituminous coal mined in Canada. The company is now shipping two 500-hp. units for operation on wood for the government of the Netherlands at Sumatra, Dutch East Indies.

IRVING E. BROOKS, recently with the Pensacola Shipbuilding Company as assistant to the naval architect and formerly electrical engineer with the Arnold Company, has opened an office as consulting engineer at 807 Stock Exchange Building, Chicago, for the practice of general engineering work. Mr. Brooks was formerly in charge of mechanical work in the city engineer's office and prior to this was on the engineering staff of the Commonwealth Edison Company.

THE ILG ELECTRIC VENTILATING COMPANY, Chicago, Ill., announces the development of a sales promotion department in charge of G. C. Bleidert. In order to enlarge its factory space the company has placed upon the market $400,000 worth of first mortgage 6 per cent. serial bonds. Within the past year sixty "Ilgair" unit heaters were installed in the new Ford "sub-chaser" plant in Detroit. The company states that its sales policies are becoming more and more strengthened and finds it necessary to discourage the selling of its product by any one other than recognized electrical and heating and ventilating trade.

THE COLE STORAGE BATTERY COMPANY, 219 East Twenty-fourth Street, Chicago, has purchased property at 2435-2439 Indiana Avenue, which will be improved with a factory to cost $10,000.

THE KILLARK ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces the return of Joseph Desloge, president of the company, from France, where he saw two years' active service as an officer in the French army.

THE BENNETT ARRESTER COMPANY has been formed at Atlanta, Ga., to manufacture a new design of high-voltage lightning arresters. The officers are C. E. Bennett, M. P. Maxwell and G. N. Lemmon. Mr. Lemmon, general manager, was recently with the Railway & Industrial Engineering Company, Pittsburgh, Pa.

C. S. COLER, who was graduated as an electrical engineer from Cornell University in 1911, after which he entered the graduate student course of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., has been appointed manager of the educational department of the Westinghouse company, and president of the Casino Technical Night School. He

C. S. COLER

succeeds C. R. Dooley, who has joined the Standard Oil Company to promote educational work in that organization. Mr. Coler was formerly manager of the entire evening school and director of trades training of the company.

THE BRANDYWINE FIBRE PRODUCTS COMPANY, Wilmington, Del., announces that Norman Sparks has been placed in charge of manufacturing. Additional machinery and special equipment have been added to handle the vulcanized-fiber tubing business. The company states that it believes in concentrating and giving its whole time and attention to the manufacture of hard vulcanized-fiber tubing, as in that way it can serve the trade to better advantage than otherwise.

THE MUTUAL ELECTRIC & MACHINE COMPANY, Detroit, Mich., has purchased a three-and-a-half-story reinforced concrete building at the corner of Fourth and Porter Streets, formerly occupied by the Doble Detroit Steam Motors Company. Alterations and additions will be made to allow for ultimate floor space of approximately 100,000 sq.ft. H. J. L. Frank is president and L. H. Frank is secretary. The company maintains sales offices and carries stock in New York, Chicago and San Francisco.

THE ELECTRICAL MANUFACTURING COMPANY, 41 Alexander Street, Vancouver, B. C., will erect a new factory in that city. A large site has been secured, and a factory, 50 ft. by 110 ft., of heavy mill construction, covered with galvanized iron, will be built. Extra full equipment of machinery has been ordered for manufacture of heavy-type slate-back switches and the new type of externally operated switches, which will be compulsory under the amendments to the electrical bylaw effective July 1. The company hopes to be turning out electrical equipment early in July.

THE REYNOLDS ELECTRIC COMPANY, 426 South Talman Avenue, Chicago, has filed plans for a new brick manufacturing plant at 2634-2644 Congress Street, to cost $85,000.

HOLBROOK, MERRILL & STETSON, of San Francisco, have been appointed agents for the Simplex Electric Heating Company, Cambridge, Mass., in California, Arizona and Nevada.

PASS & SEYMOUR, INC., Syracuse, N. Y., manufacturers of electrical supplies, announces that its export department has removed to 66 West Broadway, New York City, where all export inquiries should be sent.

THE ELECTRICAL MANUFACTURING COMPANY, Cleveland, Ohio, whose new address is 4149 East Seventy-ninth Street, announces that it has increased its machinery equipment about 40 per cent since the first of the year.

DAVID McNAUGHTON has opened an office at 528 Lincoln Life Building, Fort Wayne, Ind. He will specialize in report and rate investigations of electric light and power companies, illuminating surveys, valuations and industrial engineering.

THE J. P. DEVINE COMPANY, Buffalo, N. Y., manufacturer of vacuum drying apparatus, announces that S. S. Wells, second vice-president, has taken charge of the sales department. The company has established new sales offices in Chicago and in Cuba and the Philippine Islands. It has recently shipped to the Philippine Islands an extraction plant of new design and to a concern in the United States a large impregnating unit for electric cables.

W. G. BALPH has been appointed manager of the safety switch section of the Westinghouse Krantz factory, Brooklyn, N. Y. As head of this section Mr. Balph will have entire responsibility for the sale of all Krantz products, and in addition will have charge of the extension and development of this line to meet the needs of the country for safety switches. Prior to working as salesman in the New York office Mr. Balph was head of the fan-motor division with offices at East Pittsburgh, Pa.

THE DUBILIER CONDENSER COMPANY, INC., 217 Centre Street, New York City, announces that it has changed its factory from war to peace production and is now making mica condensers especially for line and machine protection from high-frequency surges and lightning discharges. At present it is experimenting with condensers for power-factor correction. This problem has been given serious consideration by its London company, which is now experimenting with a 2-kw. plant at its works, with satisfactory results.

THE KILBOURNE & CLARK MANUFACTURING COMPANY, Seattle, Wash., radio apparatus, with American sales offices at Seattle, New York City and San Francisco, has recently made some additions to its foreign agencies, now bringing the number of these agencies to something over 100, representing practically every country in the world. Its new factory, covering approximately one and one-half acres of floor space, has recently been completed. C. B. Cooper is in charge at New York City, and D. F. Mahaffy at San Francisco.

THE HENRY ENGINEERING COMPANY announces that it has opened offices at 71 Bay Street, Toronto, Canada, as consulting engineers on general engineering work. It has also opened a department at this address which will specialize in the purchase and sale of power equipment of every kind—steam, electrical and hydraulic—both new and used. The new company will continue to handle the special agencies carried in the past by Thomas Henry at 58 Front Street, West, and will also from time to time add other lines of engineering equipment and supplies.

THE ELECTRO DYNAMIC COMPANY, Bayonne, N. J., announces that since the first of January, 1919, its sales department, conducted under the supervision of D. B. Wilson, formerly of the General Electric Company, has extended its plans of distribution by establishing agencies in the principal cities east of the Mississippi. The factory has been increased 10 per cent. during the last year, it is stated, and has been equipped with the most modern machine tools capable of meeting the stringent demands of the day. Foreign trade is in the process of development, an order from Belgium for twenty motors having been received in February.

THE SHELTON ELECTRIC COMPANY has moved from 30 East Forty-second Street to 16 East Forty-seventh Street, New York City.

THE STANDARD ELECTRIC COMPANY, Newark, N. J., has acquired a portion of the building at 126 Pell Street and will establish a plant.

THE B. A. WESCHE ELECTRIC COMPANY, Cincinnati, Ohio, reports that its New York address has been changed to 110 West Fortieth Street.

F. J. McMORRAN has succeeded George Bonnell, resigned, in charge of the St. Louis office of the Underfeed Stoker Company of America.

THE ELECTRIC SALES SERVICE COMPANY has removed its sales office from 109 Stevenson Street, San Francisco, to 2532 Sixth Street, West Berkeley, Cal., where the headquarters are located.

THE F. BISSELL COMPANY, Toledo, Ohio, jobber and manufacturer of electrical supplies and machinery, announces that W. J. Crawford has been made manager of the power-apparatus department.

THE INDUSTRIAL ELECTRIC FURNACE COMPANY, 53 West Jackson Boulevard, Chicago, announces that it now owns all patents covering the Snyder electric furnace, F. T. Snyder, formerly vice-president, having left the organization, effective June 1.

THE BECKMAN & LINDEN ENGINEERING CORPORATION is installing a 100-kw. electric furnace in its laboratories at 41 Minna Street, San Francisco, Cal., to be used in research and investigation work for its clients. The corporation believes that this is the only electric furnace installed for such purposes west of Niagara Falls.

THE BETSON PLASTIC FIRE BRICK COMPANY, INC., announces that with its recent incorporation Frank J. Jewell was elected president and secretary, and Nelson Adams vice-president and treasurer. The company's products are plastic fire brick for boiler-furnace linings and baffle walls and "Hi-Heat" cement for use in the boiler room.

MAJOR SAMUEL W. FLEMING, JR., electrical engineer, member of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Pa., has returned from overseas after two years' service in the army. The firm will now resume its practice in electrical engineering, a branch of its business which was discontinued to a large extent during the war.

GRIGGS & MYERS, consulting engineers, New York City, desire to announce their recent affiliation with Charles A. Fuller, heating engineer of New York, and Osborn Monnett, heating engineer of Chicago, as associates. Mr. Fuller is a specialist in heating and ventilating, and Mr. Monnett enjoys a wide reputation as an authority in the field of combustion and power-plant economics.

THE METROPOLITAN ELECTRIC MANUFACTURING COMPANY, Long Island City, N. Y., announces that Patrick J. Shelley, treasurer of the company, is now general sales manager. E. S. White, Jr., has been promoted to manager of agencies. The company is making a special effort to work with the jobbers throughout the country and has established agencies in almost every large center.

THE SAFETY INSULATED WIRE & CABLE COMPANY, Bayonne, N. J., announces that Foster Callahan, formerly of the American Electrical Works, has returned from service as a first lieutenant of field artillery and is its representative in several Southeastern states. F. H. Donohoe, formerly associated with the National Conduit & Cable Company, is special representative of the Safety company as of June 1.

THE PREMIER RUBBER & INSULATION COMPANY, Dayton, Ohio, announces that it has recently enlarged its factory space, having acquired an additional 15,000 sq.ft. of floor space. To its line of molded electrical insulation has been added a line of mechanical rubber goods, both soft and semi-hard rubber products being manufactured to specification. The sale of its products is handled entirely at the home office and plant at Dayton.

THE WIZARD ELECTRIC LAMP COMPANY, San Francisco, Cal., announces that it has just moved into new and larger quarters at 521 Howard Street. This move was necessitated by the increase of sales in local territory as well as in foreign countries. Through additional machinery the company has been able to more than quadruple its former output. Its traveling representative, Harold W. Bennett, who has made extensive trips through foreign countries during the last year, reports a very bright outlook for the export business throughout South America, especially in Brazil and Argentina.

Trade Publications

SINGLE-PHASE MOTORS. — The Wagner Electric Manufacturing Company of St. Louis, Mo., has issued bulletin No. 118 on single-phase motors.

STOKER.—In a circular about its type E stoker the Combustion Engineering Corporation, 11 Broadway, New York City, shows details of its improved dumping arrangement.

HIGH-TENSION SWITCHES.—The Pacific Electric Manufacturing Company, 827 Folsom Street, San Francisco, Cal., has issued bulletin No. 600 on high-tension disconnecting switches.

MILL-TYPE LAMP.—The new Westinghouse "Mazda B" mill-type lamp is the subject of a mailing folder circulated by the Westinghouse Lamp Company, 165 Broadway, New York City.

CURRENT TAPS. — Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing circular No. 183, covering double current taps, single current taps and pull-socket current taps with screw bases.

FLUSH RECEPTACLE.—Flush receptacles with adjustable aligning plates are covered in bulletin No. 16-11 issued by Harvey Hubbell, Inc., Bridgeport, Conn., which is to supersede bulletin No. 16-3.

MULTIPLE ATTACHMENT PLUGS.—Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing bulletin No. 16-10 on multiple attachment plugs—in both screw-base and knife-blade contact styles—with porcelain caps.

ELECTRICAL AND STEAM MACHINERY.—The National Power Machinery Company, 1914 Scranton Road, Cleveland, has issued stock list No. 20, covering electrical and steam machinery for light, power and heat.

ELECTRIC IRON.—"The Aristocrat of the Laundry" is the title of a folder illustrative and descriptive of the C-H electric iron being furnished by the Cutler-Hammer Manufacturing Company of Milwaukee and New York.

OIL SWITCHES AND CIRCUIT BREAKERS.—The Condit Electrical Manufacturing Company of South Boston, Mass., has issued bulletin No. 435, describing and illustrating type F-6 oil switches and circuit breakers.

ELECTRIC RANGES. — The Hughes Division, Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is mailing to dealers a folder showing reproduction of its electric range advertisements in national popular magazines.

ELECTRICAL MEASURING INSTRUMENTS.—The Jewell Electrical Instrument Company, 1646 Walnut Street, Chicago, has issued catalog No. 12, containing illustrated descriptions of its electrical measuring instruments, both portable and switchboard types.

MOLDED ELECTRICAL INSULATION. —The International Insulating Corporation, foot of Mechanic Street, Springfield, Mass., has prepared a twenty-two-page booklet telling about its "synthetic composition" and "rubber substitute" molded electrical insulations.

INDUSTRIAL TRUCK CONTROLLERS. —"Ogden type NS" automatic controllers for storage-battery industrial trucks, tractors and engines are the subject of bulletin No. 615, a twelve-page illustrated folder from the Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio.

HOUSEHOLD APPLIANCES. — The Hotpoint Division of the Edison Electric Appliance Company, Ontario, Cal., and 5660 West Taylor Street, Chicago, is distributing a colored folder about its dealer-helps. A parts list and a parts price list, known as forms No. 1500-25219 and No. 5500, are also available.

New Incorporations

THE EASTLAND (TEX.) ELECTRIC & GAS COMPANY has been incorporated by H. P. Brelsford and others. The company is capitalized at $50,000.

THE WYNONA (OKLA.) PUBLIC SERVICE & MANUFACTURING COMPANY has been incorporated with a capital stock of $30,000 by Earl Chowins and others.

THE MAPLETON LIGHT & POWER COMPANY of Provo, Utah, has been incorporated with a capital stock of $2,000 by J. P. Johnson, H. Johnson, P. Nelson and M. Johnson.

THE NEW LAND LAMP COMPANY of Newark, N. J., has been incorporated by Nicholas Striglia, R. J. Farese and Michael Bonito. The company is capitalized at $100,000, and proposes to manufacture lighting fixtures, etc.

THE COLEMAN-MILLER ELECTRIC COMPANY, 516 West Grace Sreet, Richmond, Va., has been organized to manufacture electrical appliances and equipment. James A. Miller and associates are interested in the company.

THE A. C. ELECTRICAL MANUFACTURING COMPANY of Dayton, Ohio, has been incorporated with a capital stock of $100,000. R. H. Croninger, Fifth Street and Norwood Avenue, Dayton, Ohio, is interested in the company.

THE E. W. HALL ELECTRICAL COMPANY of Los Angeles, Cal., has been incorporated by E. W. Hall, Elihu Goldson and Herman Barney. The company is capitalized at $10,000 and proposes to manufacture electrical equipment.

THE BRYAN WASHING MACHINE COMPANY of Bryan, Ohio, has been incorporated by E. C. Carroll, N. W. Carroll and Harry Huffman. The company is capitalized at $50,000 and proposes to manufacture electric washing machines.

THE BUFFALO POWER COMPANY of Lenoir, N. C., has been chartered with a capital stock of $125,000 by T. H. Broyhill, J. E. Broyhill, and R. S. Crisp of Lenoir. The company proposes to generate and distribute electricity for lamps, heaters and motors.

THE RADIANT LIGHTING FIXTURE COMPANY of New York, N. Y., has been incorporated by H. E. Bohl, Abraham Miller and Samuel Miller, 1276 Grant Avenue, the Bronx. The company is capitalized at $5,000 and proposes to manufact re lighting fixtures.

THE CHARLES B. SCOTT COMPANY of Scranton, Pa., has been incorporated by Charles B. F. Stewart and C. Ezra Scott, both of Scranton. The company is capitalized at $250,000 and proposes to manufacture machinery, engines, electrical supplies, automobile, mine and mill parts.

THE BRAZIL LIGHT, TRACTION & POWER COMPANY of Wilmington, Del., has been incorporated with a capital stock of $1,000,000 to operate electric light and power plants and other public utility properties, etc. The incorporators are T. L. Croteau, P. B. Drew and C. L. Rimlinger.

THE ROBERT SCOTT COMPANY of Philadelphia, Pa., has been chartered with a capital stock of $15,000 by John G. Hughes, of Haddonfield, N. J., and Bernard A. Illoway, 6638 Green Street, Philadelphia, Pa. The company proposes to manufacture power and mechanical equipment.

THE SPARDON ELECTRIC PRODUCTS COMPANY of Ottawa, Ont., Can., has been chartered by Richard J. Sims, Albert E. Honetwell, John C. Grant and others. The company is capitalized at $50,000 and proposes to manufacture electrical and mechanical signals, machinery, tools, etc.

THE ROANOKE (VA.) ELECTRICAL CONSTRUCTION COMPANY has been incorporated with a capital stock of $10,000 to do general electrical construction work and to deal in electrical supplies, etc. The officers are: H. K. Stone, president; R. A. Bondurant, vice-president, and J. C. Bondurant, secretary and treasurer.

THE PROSPECT ENGINEERING & WELDING COMPANY of Brooklyn, N. Y., has been incorporated by F. J. Walkowski, 108 Pearsall Street, Long Island City, and W. H. Johnson, 55 Hanson Place, Brooklyn. The company is capitalized at $100,000 and proposes to do a general contracting, electrical and welding business.

New England States

NASHUA, N. H.—The Nashua Manufacturing Company has entered into a contract with the Manchester Light, Heat & Traction Company to furnish electricity to operate its mill for a year or more, until its new power plant is completed. The Nashua company is planning to erect a large hydroelectric plant and operate its mills entirely by electricity.

FAIRFAX FALLS, VT.—Work has started on the construction of the new power plant of the Public Electric Light Company of St. Albans. The plant will be located on the opposite side of the Lamoille River from the present power house. The new plant will have a generating capacity of 4000 hp.

BOSTON, MASS.—Plans are being prepared by the Board of Waterworks for extensive additions to the high-pressure water system, including the installation of two multi-stage turbine centrifugal pumps, each with a capacity of about 3000 gal. per minute, at the power station of the Boston Elevated Railroad at Lincoln Street, and two electrically driven units of the same rating and capacity at the power house of the Edison Electric Illuminating Company at Atlantic Avenue. The installation at both plants will include auxiliary operating equipment. The plans provide for the installation of a third unit at both plants later on. The installation of two additional motor-driven pumps at the Edison company's power station on Stanhope Street is also contemplated.

LOWELL, MASS.—Work, it is understood, will begin at once on the extension to the power plant of the Massachusetts Cotton Mill.

NEW HAVEN, CONN.—Contract has been awarded by the Seamless Rubber Company for the erection of a manufacturing plant in New Haven, to cost about $1,000,000. Details for equipment for power plant and factory have not yet been decided upon.

NEW LONDON, CONN.—Contract for electrical work for the new dormitory building to be erected at the Connecticut College for Women at New London, to cost about $100,000 has been awarded to the Delta Electric Company, 5 Barton Street, Worcester, Mass.

Middle Atlantic States

BABYLON, N. Y.—Plans, it is reported, are under consideration by the Babylon Railroad Company for the installation of an electric generating plant. The company now purchases energy to operate its system.

BINGHAMTON, N. Y.—The Endicott-Johnson Corporation has awarded the Binghamton Light, Heat & Power Company a contract for wiring and supplying electricity for thirty-six new houses to be built by the company.

CHATHAM CENTER, N. Y.—Steps have been taken by the residents of Chatham Center to secure electric service here.

NEW YORK, N. Y.—Plans are being prepared by McKenzie, Voorhies & Gmelin, architects, 1123 Broadway, New York City, for the erection of a telephone exchange building for the New York Telephone Company on Tratman Avenue, west of Rowland Street, to cost about $200,000.

PLATTSBURG, N. Y.—The Plattsburg Gas & Electric Company has been granted a franchise to install a lighting system in Schuyler Falls. Surveys are being made by the company for the erection of transmission lines from its local plant to Cadyville to furnish electricity in that village.

ROCHESTER, N. Y.—Arrangements are being made by the North East Electric Company, 348 Whitney Street, for the erection of a six-story plant, 61 ft. by 206 ft. The company, it is understood, is planning to manufacture electric starting and lighting systems. H. W. Fowler is superintendent of construction.

ROCKAWAY, N. Y.—Plans are being prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the installation of an electric plant and distributing system at the local naval air station, to cost about $60,000. (Specification 3958.)

SPENCERTOWN, N. Y.—The Chatham Electric Light, Heat & Power Company is extending its electric transmission lines to Spencertown. For the present electricity will be provided for domestic lighting only.

TRENTON, N. J.—Plans have been completed by the Hutchinson Storage Battery Company, 230 South Warren Street, for the erection of a new storage-battery plant and administration building.

HARRISBURG, PA.—Notice has been filed with the Public Service Commission of bond issues by the following companies: Metropolitan Edison Company of Reading, $45,000 in bonds; Sayre (Pa.) Electric Company, $8,000 in bonds; Harrisburg (Pa.) Light & Power Company, $50,000 in bonds; Beaver County Light Company of Pittsburgh, $24,000 in bonds; Philadelphia (Pa.) Electric Company, $1,803,205 in capital stock, and the Lehigh Valley Light & Power Company of Allentown, $15,600 in capital stock.

LEBANON, PA.—Extensive improvements are contemplated to the local plant of the Bethlehem Steel Company, including extensions to power plant, erection of new warehouse and installation of new threading departments. The proposed work, it is understood, will cost about $5,000,000.

MOUNT JEWETT, PA.—The Interstate Public Service Corporation of Rochester, N. Y., has applied for a franchise to supply electricity in Mount Jewett. If a franchise is granted the Mount Jewett tannery, it is understood, will be equipped for electrical operation.

PHILADELPHIA, PA.—The Niles-Bemont Pond Company is contemplating the construction of a power plant at Meadow and Mifflin Streets.

PHILADELPHIA, PA.—Contract has been awarded to Horace H. Burrell, Philadelphia, for the erection of a new power plant at the Orthopedic Hospital, Seventeenth and Sansom Streets.

READING, PA.—Plans have been prepared by the Philadelphia & Reading Railroad Company for the erection of a power plant, 38 ft. by 50 ft., at its local properties.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 16 for installing lighting fixtures in the south building, Hygienic Laboratory, United States Public Health Service, Washington. For details see Searchlight Section.

North Central States

DETROIT, MICH.—Contracts will soon be awarded by the Public Lighting Commission for construction of conduit in John R. Street to the new Public Library, in Cass Avenue from Grand River Avenue to Willis Avenue, in Chene Street from Grand River Avenue to Boulevard, in Kercheval Avenue from Mount Elliott to Hurlbut Avenue, and in Junction Avenue from Michigan Avenue to Michigan Central Railroad viaduct. The work will consist of 5¼ miles of 1-5-in. duct conduit, 17 manholes, 170 handholes and 350 lamp-pole foundations. F. T. Bowler, 56 East Atwater Street, is secretary.

AKRON, OHIO.—The Public Utilities Commission has granted the Northern Ohio Traction & Light Company permission to issue $4,998,000 in bonds. Part of the proceeds, it is understood, will be used for improvemennts.

CLEVELAND, OHIO.—Plans are under consideration by the Crucible Steel Castings Company, Champlain Avenue, for the erection of an electric steel foundry on seven-acre site on the Big Four Railroad and Elmira Avenue, near Dennison Avenue, S. W., this fall. The plans provide for the installation of two electric furnaces.

DAYTON, OHIO.—The Public Utilities Commission has authorized the Dayton Power & Light Company to issue $232,000, the proceeds to be used for completion of a transmission line between Wilmington and Xenia and for other improvements under way.

LORAIN, OHIO.—Work will begin at once on improvements to the local system of the Lorain County Electric Company. The cost is estimated at about $90,000 and will include the reconstruction of the electric distribution system, erection of new substation and the installation of new copper wire. The new power plant will be completed in August.

MARION, OHIO.—The street-lighting committee has petioned for extensions to the street-lighting system.

ELKHART, IND.—A special election will be held July 2 to submit to the voters the proposal to issue $60,000 in bonds for extensions and improvements to the municipal electric light plant and waterworks system.

GARY, IND.—Work will soon begin on the first unit of the Gary Tube Works. The first unit will cost approximately $25,000,000 and will consist of four blast furnaces, three Bessemer converters, blooming mills, plate mills, skelp mills, tube mills and soaking pits.

INDIANAPOLIS, IND.—The contract for the construction of the power house of the G. & J. Tire Company at Georgie and Cook Streets has been awarded to the William P. Jungclaus Company of Indianapolis. The cost is estimated at about $50,000.

INDIANAPOLIS, IND.—Bids will be received until July 11 for the construction of the first division of the sewage disposal plant for the city of Indianapolis, to cost about $2,000,000. The cost of the first division will be about $300,000. The plans provide for building the system in five divisions, the first two to be completed this year. The pumping station will be equipped with six electrically driven pumps with a daily capacity of 100,000,000 gal.

MONTICELLO, IND.—The local electric light plant of the Interstate Public Service Company of Indianapolis was badly damaged by the carrying away of the dam across the Tippecanoe River. The loss is estimated at between $40,000 and $50,000. The plant furnishes electricity for twelve towns.

ATHENS, ILL.—The Athens Electric Light & Power Company is contemplating extending its electric transmission lines to Cantrall, Indiana Point and Fancy Prairie.

CHICAGO, ILL.—Plans have been filed by the Reynolds Electric Company, 426 South Talman Avenue, for the erection of a new manufacturing plant at 2634-44 Congress Street, to cost about $85,000.

COLUMBIA, ILL.—Bids will be received by E. H. Brucker, village clerk of Columbia, Ill., until June 30 for construction of a municipal electric light and power plant. The work consists of removing the present 14-ft. by 60-in. boiler and smokestacks of both boilers, furnishing and installing one new boiler, engine, generator, exciter, switchboard, heater, boiler-feed pump, steam separator, trap, pipe work and covering, erecting concrete chimney, horizontal breeching, constructing concrete foundation for new equipment, and an addition to power house. The changes must be made without interruption to the service of the plant. Plans and specifications may be seen at the office of the village clerk, Columbia, and at the office of Fuller & Beard, engineers, Chemical Building, St. Louis, Mo.

PETERSBURG, ILL.—Farmers in portions of Mason, Menard, Cass and Sangamon Counties are organizing a company, to be known as the Little Grove Light & Power Company, for the purpose of erecting transmission lines (about 40 miles) to connect with the lines of the Abbott Light & Power Company of Petersburg.

ROCK ISLAND, ILL.—The plant of the Victor Storage Battery Company will be removed from Moline to Rock Island, and a new factory, to cost about $52,000, will be erected here.

URBANA, ILL.—The installation of an ornamental lighting system for the entire southwest portion of the city, adjacent to the campus of the University of Illinois, to cost about $100,000, is under consideration by the City Council.

VIENNA, ILL.—The installation of a municipal electric light plant in Vienna is under consideration by the City Council.

ELROY, WIS.—Bids are being asked for the purchase of $22,000 in electric light bonds.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company is asking for bids for the erection of a substation, 60 ft. by 80 ft., at Twenty-sixth avenue and Burnham Street. Plans are on file in the office of R. H. Pinkley, Public Service Building.

BRAINERD, MINN.—Bids will be received by the City Council until July 7 for pumping equipment consisting of two motor and engine-driven, three-stage centrifugal fire pumps, each of 1000 gal. per minute capacity; two motor and belt-driven vertical centrifugal low-service pumps, each of 900 gal. per minute capacity; one motor-driven centrifugal low-service pump of 1200 gal. per minute capacity, and two motor-driven sump pumps. Plans and specifications may be

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

seen at the office of R. T. Campbell, city engineer, Brainerd, and at the office of L. P. Wolf, consulting engineer, Guardian Life Building, St. Paul, Minn.

GENEVA, MINN.—The installation of a municipal electric light plant in Geneva is under consideration by the City Council.

HUTCHINSON, MINN.—Work, it is understood, will be resumed on the extension of the Electric Short Line from Hutchinson to Clara City, a distance of 54 miles. Col. Erie D. Luce will have charge of the work.

LE SUEUR, MINN.—Bids will be received by Thomas Hessian, clerk of school board, Le Sueur, until July 7 for new boilers, new pump and receiver, motor and gasoline engine, repairs to the present heating plant and new coal bunkers for the high school building. Plans and specifications may be seen at the office of Harry W. Terry, engineer, St. Paul, and the clerk of school board, Builders' Exchanges, Minneapolis and St. Paul.

SUPERIOR, MINN.—Plans are under consideration for the rearrangement of the entire street-lighting system in Duluth, with the installation of ornamental lamps on Superior Street. The Duluth-Edison Company has the contract for lighting the city. C. A. Van Bergen is treasurer and manager of the company.

TYLER, MINN.—Bids will be received by the Village Council until July 8 for equipment for the municipal electric light plant, including an 80-hp. to 125-hp. either oil or gas engine with producer gas; generator, belt-driven or direct connected, three phase, 60 cycles, 2300 volts, to be run in parallel, exciter and switchboard complete. John Johnson is village recorder.

BURLINGTON, IOWA.—The American Utilities Company, recently organized to furnish electrical service in Des Moines County, has petitioned for a franchise to erect electric transmission lines on every public highway in six townships in Des Moines. The company proposes to supply electricity for lamps and motors to the residents of towns or rural communities in the townships of Augusta, Concordia, Danville, Pleasant Grove, Washington and Yellow Springs.

STORY CITY, IOWA.—Bids will be received by the city of Story City until July 7 for construction of electric light plant. The equipment will include an engine, generator, switchboard, constant-current transformer fire tube boiler and breeching and boiler-feed pump. The Henningson Engineering Company, National Bank Building, Omaha, Neb., has charge of the engineering work.

ST. LOUIS, MO.—The Wood & Lane Company, 915 Olive Street, it is reported, contemplates the purchase of a horizontal steam turbine-driven generator, with motor-driven surface condenser and other equipment.

ST. LOUIS, MO.—Plans have been prepared by the Scullin Steel Company, 6700 Manchester Avenue, for the construction of a rolling-mill plant, to cost about $2,000,000. The mills will be equipped with electric motor-driven machinery. Perrin & Marshall are engineers.

MANHATTAN, KAN.—The power plant of the Rocky Ford Milling & Power Company, of Abilene, 6 miles north of Manhattan, was recently destroyed by fire, causing a loss of about $150,000. Arrangements are already under way to rebuild the plant. The company supplies electricity in Manhattan, Abilene, Blue Rapids, Junction City and other small towns.

Southern States

CORNELIUS, N. C.—C. F. Asbury of Charlotte has been awarded contract for the erection of a municipal electric distributing system in Cornelius, to include the installation of transformer at point of connection with the system of the Southern Power Company, which will supply electricity to operate the local system.

SPRINGFIELD, GA.—The installation of an electric lighting plant in Springfield is reported to be under consideration.

BOWLING GREEN, FLA.—An election will soon be called to submit to the voters the proposal to issue $20,000 in bonds for the installation of an electric light plant and waterworks system.

WINTER GARDEN, FLA.—An election will be held July 5 to submit to the voters the proposal to issue $70,000 in bonds for improvements to the electric light plant and waterworks system and to construct a sewer system.

KNOXVILLE, TENN.—Steps have been taken by the Board of Commerce for a new power plant in Knoxville. A committee, composed of Larkin H. Brown, chairman; B. L. Johnson, Morris Bart, J. E. Miller and Prof. J. A. Switzer, has been appointed to raise the necessary funds and engage an engineer to make a survey of the city to determine whether a plant is advisable, and if so, whether it will be cheaper to locate the plant at the nearby coal mines or construct a hydroelectric plant.

COLDWATER, MISS.—The Town Council is considering the erection of an electric transmission line from the corporate limits of the town to Senatobia to secure electricity from the municipal electric plant there. The cost is estimated at about $10,000.

MERIDIAN, MISS.—The installation of an electric plant in the Masonic Home of sufficient capacity to maintain 300 lamps is under consideration. For further information address E. J. Martin, superintendent.

MARIANNA, ARK.—The installation of an electric lighting system in Marianna is under consideration by T. E. Hobbs and others.

SPRINGDALE, ARK.—Contract has been awarded by the city of Springdale for construction of an electric light plant, waterworks and sewer system to Frank L. Wilcox, engineer, Syndicate Building, St. Louis, Mo.

NATCHITOCHES, LA.—The City Commission has engaged Xavier A. Kramer, of Magnolia, Miss., as consulting engineer in connection with improvements to electric light plant and waterworks system and for construction of sanitary sewers and street paving. The cost of the proposed work is estimated at about $200,000.

NEW ORLEANS, LA.—The American Sugar Company is planning improvements to its power plant, including the installation of generators and other equipment.

GOTEBO, OKLA.—Bonds to the amount of $20,000 have been voted to establish a municipal electric light plant.

LAWTON, OKLA.—The City Commissioners have decided to call an election to submit to the votes the question of municipal ownership of the electric light and ice plants.

TULSA, OKLA.—The city of Tulsa is contemplating the construction of waterworks system and a hydroelectric plant, to cost about $4,853,000. The plans include construction of dams, 30 ft., 35 ft. and 50 ft. high, and hydroelectric power house, to cost $248,445; conduits, $2,900,405; three 20,000,000-gal. capacity reservoirs, $225,000; one 80,000,000-gal. capacity reservoir, $314,000; power plant, $225,000; pumping plant, $150,000; transmission lines, $360,000; engineering, $230,000; land and clearing, $150,000, and right-of-way, $50,000.

BRECKENRIDGE, TEX.—The Texas Power & Light Company of Dallas has purchased the local plant. New equipment, it is understood, will be installed at the plant.

WACO, TEX.—Plans are under consideration for the erection of the Abe Mulkey memorial building for school purposes at the Methodist Orphanage, to cost about $75,000; also a chapel, to cost $40,000. A separate building will be built for heating plant, power house and laundry. M. W. Scott, 412½ Franklin Street, is architect.

Pacific and Mountain States

KELSO, WASH.—Preparations are being made by the North Coast Power Company for rebuilding its transmision line from Kelso to Kalama. The line now carries 6600 volts and wil be rebuilt for 22,000 volts. The cost is estimated at about $30,000.

ESTACADA, ORE.—Application has been filed with the State Engineer by the Clackamas Power & Irrigation Company asking for water rights to develop 11,705 hp. The company asks for permission to take 1000 second-ft. of water from the Clackamas River near Estacada. The proposed project, which will utilize a 103-ft. fall of water, involves the construction of a ditch and flume 6.6 miles long and a dam 400 ft. long, to cost about $1,250,000.

SALEM, ORE.—The Oregon Pulp & Paper Company is contemplating the construction of a paper and sulphite pulp mill on the Williamette River, to cost about $1,000,000. C. E. Eaton, Sherman Building, Watertown, N. Y., is engineer.

FRESNO, CAL.—Preliminary work has been started by the San Joaquin Light & Power Company on its proposed hydroelectric power plant near Big Sandy in the vicinity of Auberry, to cost including equipment, about $2,000,000.

GLENDALE, CAL.—Extensive improvements are contemplated to the municipal waterworks system, including the construction of a hydroelectric power plant to supply electricity for municipal purposes. The cost is estimated at about $196,000.

LOS ANGELES, CAL.—A permit has been granted the Clune Production Company for the erection of an electric plant at its works.

LOS ANGELES, CAL.—Bids will be received by the Department of Public Service, Knickerbocker Building, Los Angeles, until July 1 for hydraulic equipment, electric generators, transformers, auxiliary electric equipment and appurtenances in accordance with Specification No. 196, on file in the office of the Public Service Commission.

PALO ALTO, CAL.—An election will soon be called to submit to the voters the proposal to issue $72,000 in bonds for the installation of a Diesel engine in the municipal electric light plant.

SAN FRANCISCO, CAL.—Contract has been awarded by the Great Western Power Company for design and construction of the proposed hydroelectric development on the Feather River in the San Francisco district, to be known as the Caribou plant. to the Stone & Webster Engineering Corporation, Boston, Mass. The initial installation will provide for an output of 40,000 kw.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Board of Public Works, City Hall, San Francisco, Cal., until July 30, for construction of the Hetch Hetchy dam and appurtenant works in Tuolumne County. The dam site is accessible directly by railroad, and electricity for construction purposes is available. Plans and specifications may be obtained from M. M. O'Shaughnessy, city engineer, upon deposit of $20.

IDAHO FALLS, IDAHO.—Bonds to the amount of $35,000 have been voted for improvements to the municipal electric light plant and waterworks system.

Canada

CALGARY, ALTA.—Improvements are contemplated to the municipal electric light plant, to cost about $50,000.

LONDON, ONT.—The Public Utilities Commission has instructed E. V. Buchanan, engineer, to prepare plans for placing the high-tension electric wires underground in the downtown section of the city. The cost is estimated at about $45,000.

TIMMINS, ONT.—The Northern Ontario Light & Power Company is contemplating the construction of a new electric station.

WALKERVILLE, ONT.—The Walkerville Hydro-Electric Commission is contemplating the construction of a power station, cost about $25,000, near the plant of the General Motors Corporation.

WINDSOR, ONT.—Arrangements are being made by the Champion Spark Plug Company of Toledo, Ohio, for the erection of a plant at Windsor, to cost about $750,000.

LUMSDEN MILLS, QUE.—Work has been started on the erection of the power house in connection with the works of the Kipawa Fibre Company now under construction at Lumsden Mills. The proposed plant will develop about 20,000 hp.

REGINA, SASK.—The municipal electric light plant was recently destroyed by fire, causing a loss of about $60,000.

SASKATOON, SASK.—The contract for construction of new intake at the municipal power house has been awarded to R. J. Arrand, at $13,550.

SWIFT CURRENT, SASK.—The municipal electric light plant was recently destroyed by fire causing a loss of about $60,000. The plant, it is understood, will be rebuilt at once.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until July 9 for furnishing steel, brass, copper, brass and copper tubing and pipe, bell metal, bearing metal, pipe covering, gaskets, etc. Blanks and information relating to this circular (1286) may be obtained from the above office, or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, New Orleans, La.

(Issued June 10, 1919)

14,665 (reissue). AUTOMATIC TELEPHONE SWITCHING APPARATUS; Talbot G. Martin, Chicago, Ill. App. filed April 3, 1917.

1,305,998. ELECTRIC SWITCH DEVICE; Albert I. Fromager and Joseph F. Six, Montreal, Quebec, Canada. App. filed Jan. 17, 1917. Wires terminating in contact plates are adapted to be connected by a sliding member for closing circuit.

1,306,018. DYNAMO-ELECTRIC MACHINE; William B. Moses, Watertown, Mass. App. filed Jan. 8, 1918. Thin sheet metal stamped and drawn into machine parts.

1,306,054. IMPULSE TRANSMITTER; Joseph C. Field, Orange, N. J. App. filed May 10, 1916. Selective for telephone party lines.

1,306,063. TELEPHONE SYSTEM; Lewis H. Johnson, Bloomfield, N. J. App. filed Jan. 2, 1918. Connection between automatic and manual exchanges.

1,306,069. METHOD OF AND APPARATUS FOR MAKING ELECTRICAL MEASUREMENTS; Ervan L. McDonald, Salt Lake City, Utah. App. filed July 5, 1916. Can measure resistance, capacity, inductance and reluctance and be used for electrical comparisons.

1,306,071. CIRCUIT BREAKER FOR IGNITION SYSTEMS; George B. Maegly, Kansas City, Mo. App. filed June 18, 1917.

1,306,072. SPEED-CONTROL GOVERNOR; Benjamin F. Merritt, East Orange, N. J. App. filed Oct. 1, 1917. Can change adjustment while motor is in operation.

1,306,074. SIGNALING SYSTEM; John F. Moran, Jersey City, N. J. App. filed June 8, 1917. Telephone.

1,306,076. AUTOMATIC MOTOR SWITCH; Winfred F. Pfister, Leipsic, Ohio. App. filed Jan. 18, 1918. Centrifugally operated.

1,306,079. CAR-LIGHTING SYSTEM; Harry D. Rohman, New York, N. Y. App. filed Feb. 20, 1917. Maintains constant voltage.

1,306,085. ELECTRIC REGULATING RESISTANCE; Ernst A. E. Thornblom, Eskilstuna, Sweden. App. filed Oct. 14, 1918. Electric welding.

1,306,087. SHEET-FEEDING DEVICE FOR PRINTING PRESSES; Frederick M. Turck and Bruce C. White, New York, N. Y. App. filed Aug. 29, 1917.

1,306,098. TIRE-UNWRAPPING MACHINE; Charles Brown, Knoxville, Tenn. App. filed Jan. 7, 1918.

1,306,116. IGNITION APPARATUS; William B. Moses, Brookline, Mass. App. filed Jan. 17, 1916.

1,306,118. DIRECTION INDICATOR FOR MOTOR CARS; Charles A. Ott, Ottawa, Kan. App. filed Aug. 15, 1918.

1,306,124. LINE SWITCH; John N. Reynolds, Greenwich, Conn. App. filed Oct. 26, 1916. Telephone switching mechanism.

1,306,134. MOUNTING FOR MAGNETO IGNITERS; Arthur R. Baker, Indianapolis, Ind. App. filed July 20, 1918.

1,306,137. ENGINE-STARTING SYSTEM; William A. Chryst, Dayton, Ohio. App. filed Sept. 30, 1915.

1,306,141. ELECTRICAL SWITCH; William Ellerd-Styles, London, Eng. App. filed May 27, 1918. Spindle makes it watertight and gas-tight.

1,306,142. CONDUIT; John M. Fitzgerald, Oak Park, Ill. App. filed June 15, 1917. Affords access to its contents.

1,306,145. AERIAL FOR AUTOMOBILE TORPEDOES; John Hays Hammond, Jr., Gloucester, Mass. App. filed March 15, 1912.

1,306,147. BATTERY ARRANGEMENT; Simon B. Hess, New York, N. Y. App. filed Dec. 26, 1914. Large ampere-hour capacity obtained while using dry cells.

1,306,151. ELECTROLYTIC APPARATUS; Philip J. Kroll, Pittsburgh, Pa. App. filed Nov. 5, 1917.

1,306,170. METHOD OF AND APPARATUS FOR ELIMINATING STATIC EFFECTS; Elmer E. Butcher, Interlaken, N. J. App. filed July 20, 1915. Adjustable inductance and capacity.

1,306,174. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Sept. 29, 1911. Dynamo regulated by carbon-pile resistance.

1,306,191. ENTRANCE-SWITCH UNIT; Clarence D. Platt, Bridgeport, Conn. App. filed March 9, 1918. Top-proof with meter.

1,306,202. AUTOMATIC CONTROLLER; John E. Thompson and Clarence W. Jameson, Chicago, Ill. App. filed April 7, 1917. Varies the resistance in the circuit motors.

Record of Electrical Patents

Notes on United States Patents

1,306,208. WIRELESS TELEGRAPHY; Roy A. Weagant, Roselle Park, N. J. App. filed Feb. 24, 1915.

1,306,212. MOTOR-CONTROL SYSTEM; Harry R. Canfield, Cleveland, Ohio. App. filed Dec. 15, 1916. Switches close in a predetermined order.

1,306,214. BATTERY; Richard J. Crowley, Dallas, Tex. App. filed May 1, 1917.

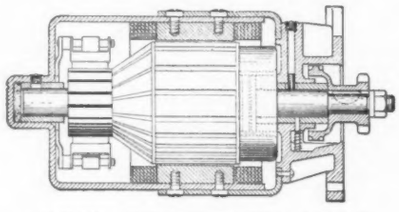
1,306,223. RADIO-TELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed May 15, 1916.

1,306,231. SPARK-PLUG INDICATOR; Charles F. Pinneo, Detroit, Mich. App. filed July 3, 1917. Determines cause of the engine trouble.

1,306,237. ELECTROLYTIC CELL; Clinton P. Townsend, Washington, D. C. App. filed July 24, 1917.

1,306,248. ACOUSTIC APPARATUS; Edward E. Clement, Washington, D. C. App. filed March 16, 1912. Relays reinforce and increase the volume of transmitted sound vibrations, without distortion or loss of sharpness.

1,306,250. ELECTRIC FURNACE; Ora A. Colby, Larimer, Pa. App. filed Oct. 13, 1917. Electric resistance.



1,306,018—Dynamo-Electric Machine

1,306,251. ELECTRIC FURNACE; Ora A. Colby, Larimer, Pa. App. filed Oct. 24, 1917. For heating steel to forging temperatures.

1,306,259. ELECTRIC LAMP; Frederick G. Keyes, Hoboken, N. J. App. filed Jan. 17, 1916. Tungsten filament of considerable diameter.

1,306,289. ELECTRIC FURNACE; Frank Thornton, Jr., Pittsburgh, Pa. App. filed Oct. 24, 1917. High temperatures are obtainable without a high rate of deterioration.

1,306,294. ELECTRIC WELDING SYSTEM; David H. Wilson, Franklin Township, Bergen County, N. J. App. filed Feb. 23, 1917. Maintains an arc from a common source of power.

1,306,298. TROLLEY HARP; Joseph Basil and Frank Girardi, Detroit, Mich. App. filed Jan. 2, 1919.

1,306,299. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Dec. 27, 1918. Duplex.

1,306,315. VOLTAGE-REGULATING MEANS FOR STORAGE BATTERIES; John J. Sinclair, Upper Montclair, N. J. App. filed Nov. 15 1916. For compressor motor on rapid transit cars.

1,306,335. ALTERNATING-CURRENT RECTIFIER; Julius F. G. Hartmann, Copenhagen, Denmark. App. filed Dec. 30, 1915. Conducting liquid jets passing through a magnetic field and striking a combined electrode dependent on the velocity of the jet and the frequency of the current.

1,306,340. ELECTRIC SWITCH; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 13, 1915. Quick break.

1,306,341. SHIFT-SOCKET METER PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed Feb. 18, 1916. Metering panel has a switch busbar mounted on the board.

1,306,342. SWITCH PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 10, 1916. Affords direct connection from a busbar to a branch-line terminal by the use of a single switch element.

1,306,343. SAFETY-SHUTTER PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 22, 1916. Readily inspected.

1,306,344. SAFETY SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 22, 1916. Protected both front and rear.

1,306,345. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Prevents the improper manual operation of two or more switches.

1,306,346. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed April 11, 1917. Insures the proper assembly.

1,306,347. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed Aug. 17, 1917. Plurality of independent operable switch mechanisms.

1,306,356. ELECTRICITY METERING; Edmund O. Schweitzer, Chicago, Ill. App. filed April 9, 1917. Circuit is electrolytically opened after a predetermined quantity of energy has been consumed.

1,306,360. SNAP SWITCH; Clarence C. Stirling, Hartford, Conn. App. filed June 22, 1917. Eliminates arcing.

1,306,406. TRUNK CIRCUIT; Hiram D. Currier, Chicago, Ill. App. filed April 5, 1915. Two-way.

1,306,410. ELECTRICAL APPARATUS FOR TRANSMITTING OR RECEIVING SIGNALS; Arthur T. Dawson and George T. Buckham, Westminster, London, Eng. App. filed June 16, 1915. Motor armatures perform intermittent or step-by-step movements.

1,306,411. LIGHTING-SYSTEM CONTROL; Evan J. Edwards, East Cleveland, Ohio. App. filed Dec. 10, 1915. Protects lamps against excessive voltage.

1,306,445. TELEPHONE-RECEIVER SUPPORT; Katharine L. Standish, New York, N. Y. App. filed Sept. 21, 1917.

1,306,474. RADIO RECEIVING APPARATUS; Alonzo N. Edmunds, Charleston, S. C. App. filed Oct. 2, 1915.

1,306,479. PROCESS FOR THE ELECTROLYTIC DEPOSITION OF LEAD; Dell F. Harbaugh, Chicago, Ill. App. filed July 5, 1918.

1,306,480. METHOD OF RECOVERING METALS FROM THEIR ORES; Dell F. Harbaugh, Chicago, Ill. App. filed July 5, 1918.

1,306,484. MOTOR CONTROLLER; Richard B. Hunter, Milwaukee, Wis. App. filed March 19, 1917. Motor-accelerating means requires resetting for successive operations.

1,306,494. PARTY-LINE SELECTIVE SIGNALING SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Nov. 29, 1909. For calling automatically.

1,306,520. INSULATING MATERIAL; Clem J. Burkley, Columbus, Ohio. App. filed Dec. 6, 1917. Asphaltic material.

1,306,525. CONSTANT-CURRENT REGULATOR; Guerney H. Cole, Mount Oliver, Pa. App. filed Dec. 4, 1915. No moving coils.

1,306,532. INDUCTION MOTOR; Bernard Elshoff, Newark, N. J. App. filed Dec. 14, 1915. Conducting bars and end rings have substantially the same electrical conductivity.

1,306,537. SYSTEM OF CONTROL; Arthur J. Hall, Wilkinsburg, Pa. App. filed Feb. 3, 1916. Governing translating device reversely manipulated to increase automatically the circuit resistance and lower the motor.

1,306,539. CONTROL SYSTEM, Rudolf E. Hellmund, Pittsburgh, Pa. App. filed July 12, 1915. Surplus field current shunt through energy-consuming devices.

1,306,542. CONTROL FOR ELECTRIC HEATING DEVICES; George H. Hill, Schenectady, N. Y. App. filed March 31, 1917. For maintaining substantially constant current.

1,306,544. MEANS FOR CONTROLLING THE CIRCUITS OF ELECTRIC MOTORS; Leonard P. Hutt, Schenectady, N. Y. App. filed May 18, 1916. Switch closed by a shunt coil under the control of the motor current.

1,306,545. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Benjamin W. Jones, Schenectady, N. Y. App. filed May 26, 1916. Limit switches.

1,306,548. MOTOR-CONTROL SYSTEM; Robert H. McLain and John Eaton, Schenectady, N. Y. App. filed June 29, 1916. Reversible for hoisting.

1,306,551. ELECTRIC SWITCH; Ezra B. Merriam, Schenectady, N. Y. App. filed June 7, 1916. Prevents ejection of oil in switches.

Vol. 73, No. 26 New York, June 28, 1919 *Pages 1365–1428*

Electrical World

F. M. FEIKER, *Editorial Director* W. H. ONKEN, JR., *Editor*

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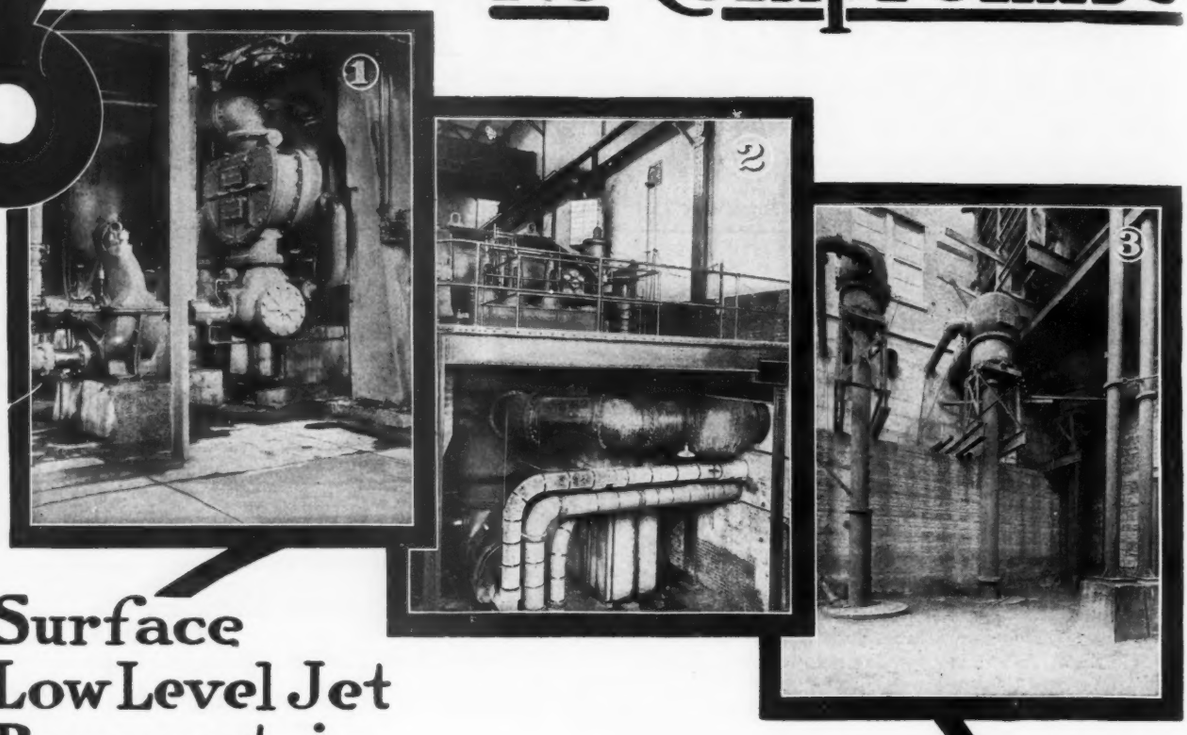
3—No Compromise



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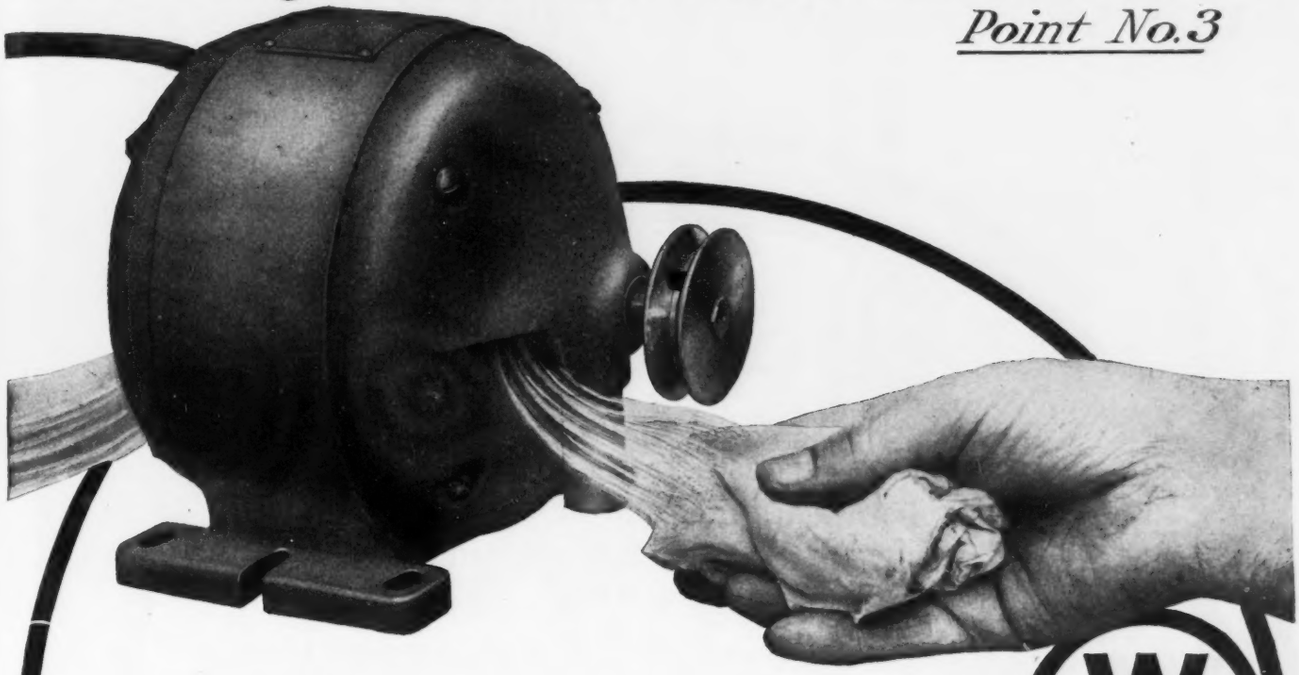

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Hold a piece of lighted cotton waste to the ventilating holes and see how the smoke rushes through the motor.

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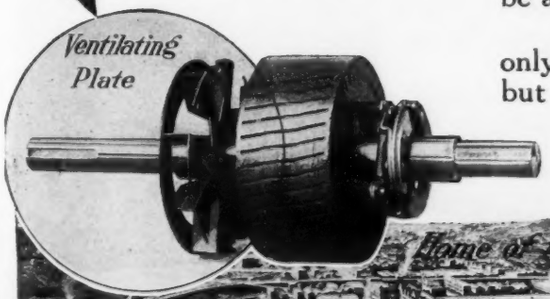

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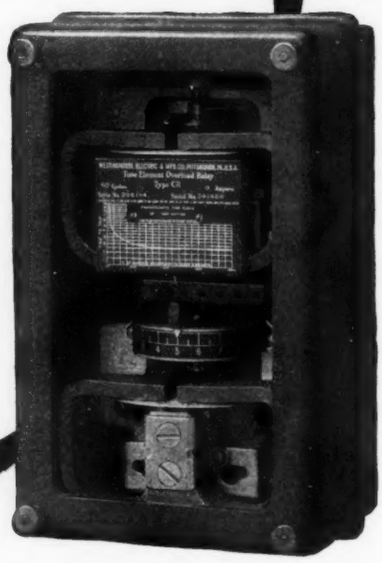

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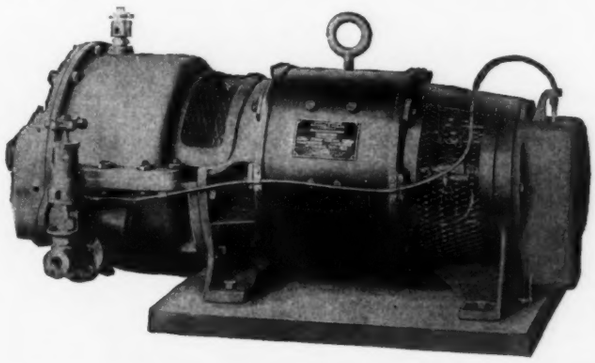

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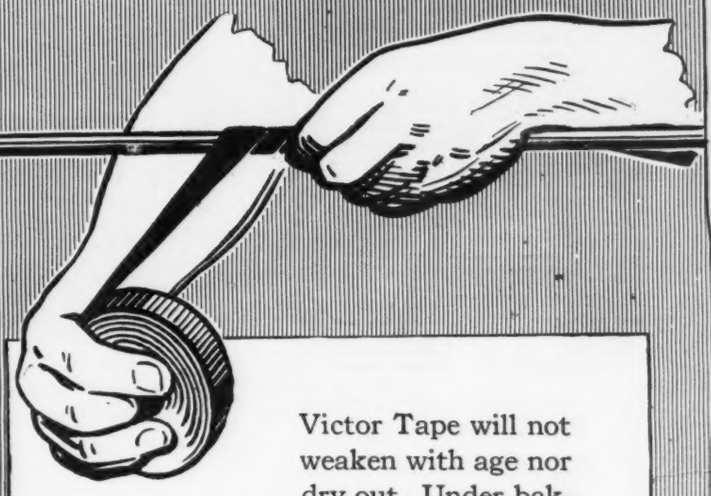

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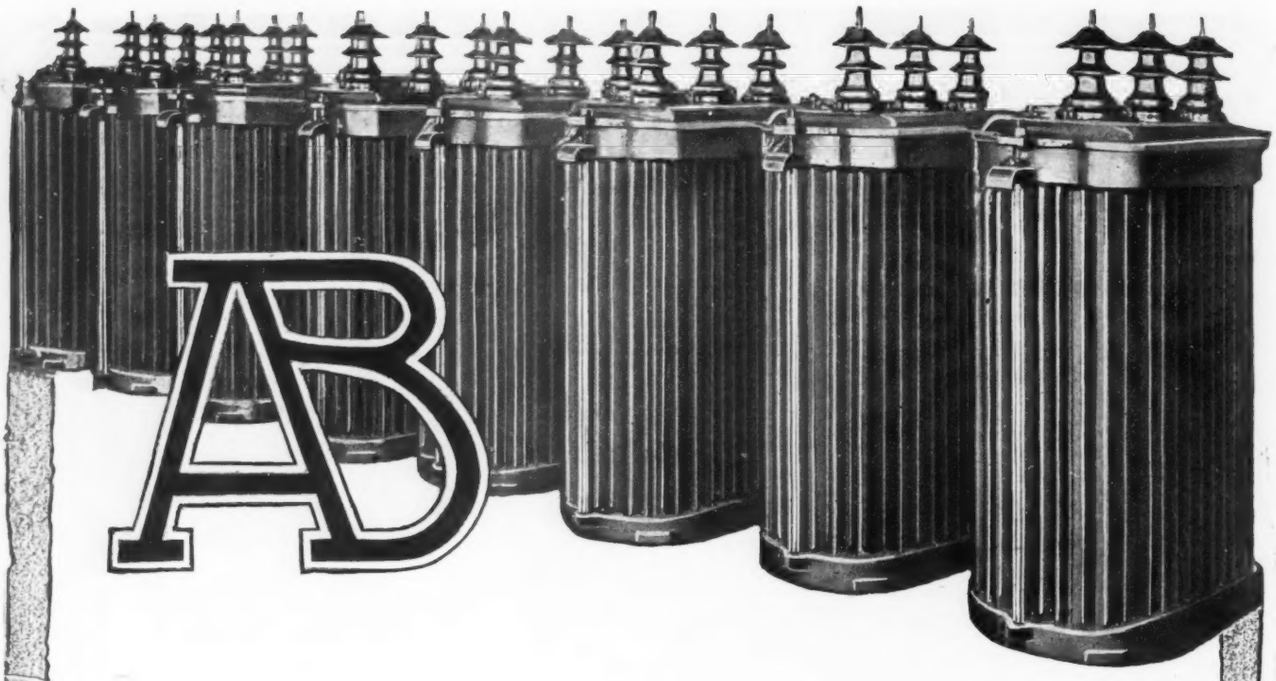

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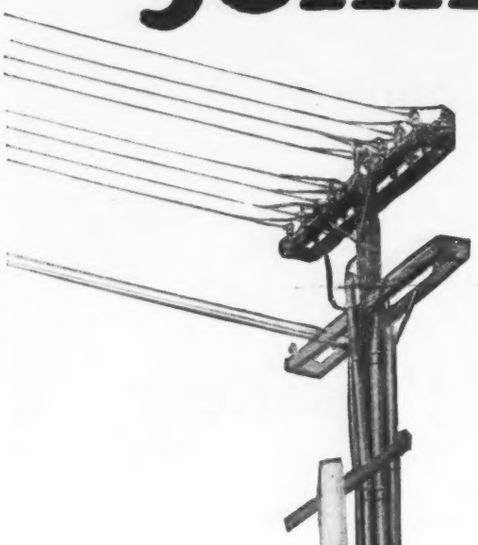

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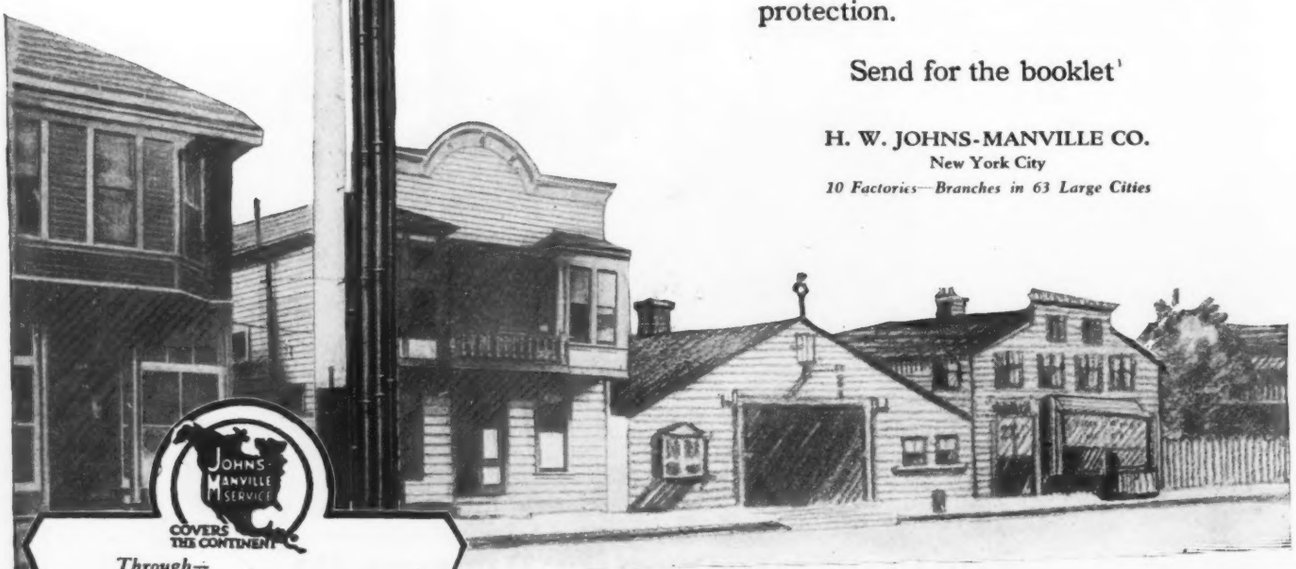

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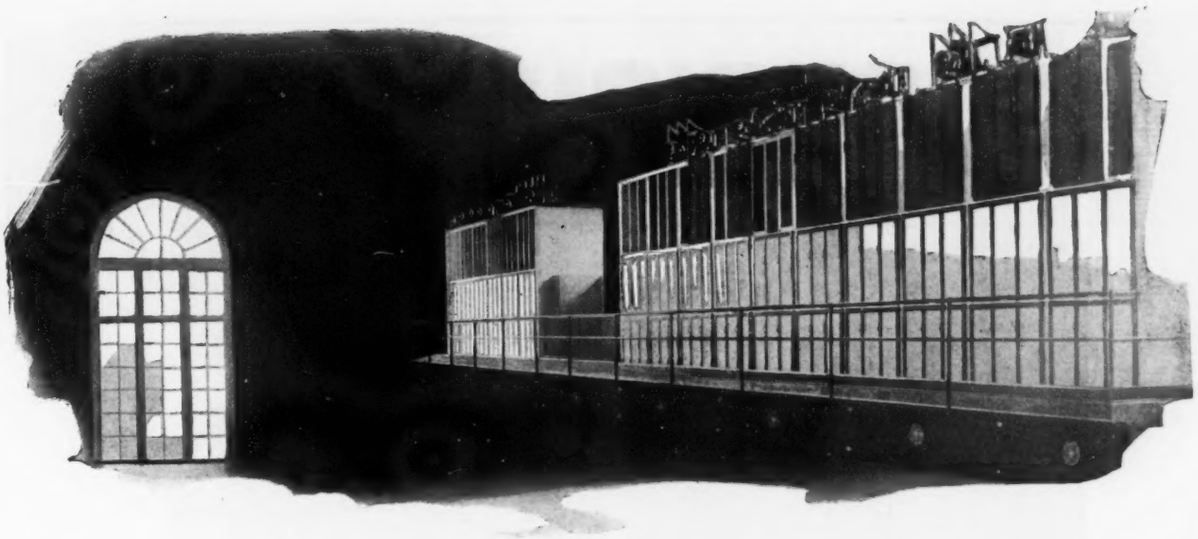

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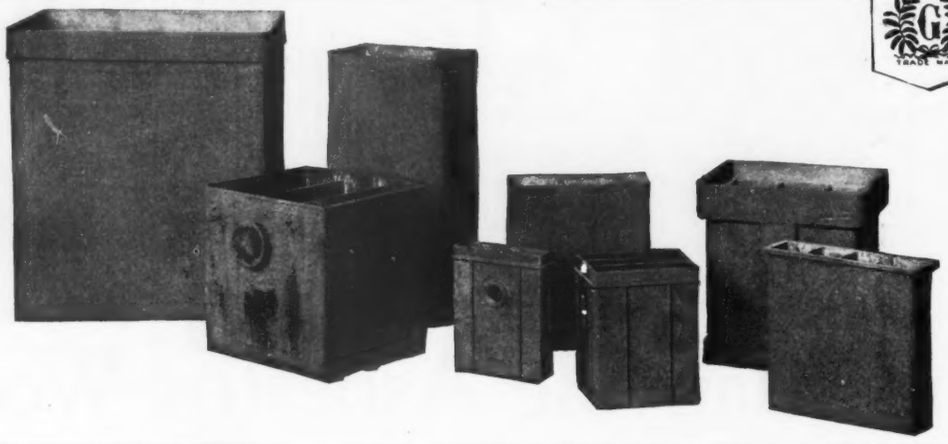

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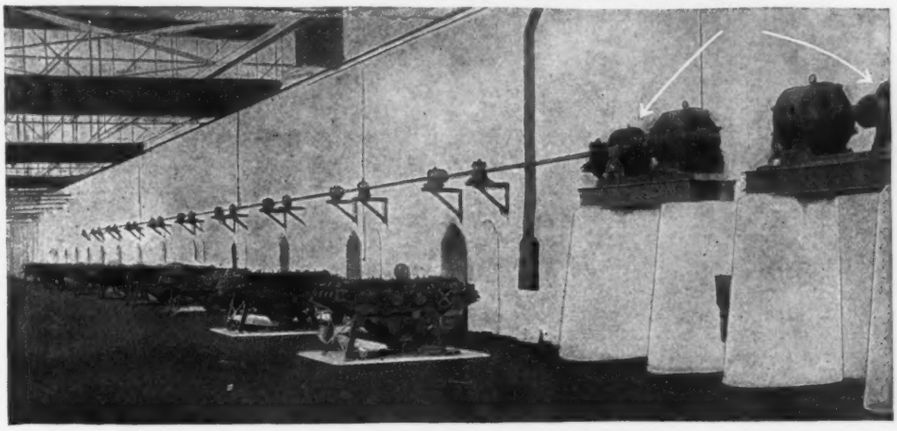

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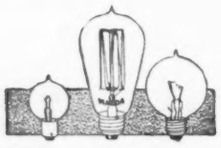

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In appearance the MAZDA C-4 is strikingly different from any lamp now on the market. The bulb is made of white glass of a peculiar opalescence. Instead of being transparent, like the standard lamp, the glass of the gas-filled MAZDA C-4 is seemingly opaque. But when the current passes through the filament, the lamp emits a brilliant yet glareless, soft and ideally-diffused light which is unlike that produced by any other lamp.

The Lamp That Sells Itself

Powerful and penetrating as is the light of the regular MAZDA lamp, there are many situations—particularly in home, office and store lighting and in other places—where it is impossible to shade the light and where consequently glare becomes a decided objection. Here the WESTINGHOUSE MAZDA C-4 lamp renders its best service.

The light of this lamp is so uniquely diffused that one may look straight at the bulb without experiencing that blinding sensation that follows an attempt to look at a lighted lamp of other types. This peculiar quality of the MAZDA C-4 makes the new lamp of the greatest value in open display racks, in stores and show windows, wherever the least glare is objectionable.

Because of its decidedly novel features and unusual efficiency, this lamp is bound to become the leader in every lamp distributor's sales. Write for full information on the new MAZDA C-4.

Westinghouse Lamp Co.
165 Broadway, New York

Sales Offices and Warehouses Throughout the Country
For Canada—Canadian Westinghouse Co., Ltd., Hamilton, Ont.

WESTINGHOUSE MAZDA LAMPS

77-20
77-20
77-20
77-20

Can You Remember This Number?
77-20

It is the number of the receptacle that should be used in every home and office. The C-H 77-20 Duplex Receptacle provides

Two Outlets in the Space Required for One

This double outlet receptacle fits the same standard outlet box used for a single outlet receptacle, and the wiring is the same also.

You provide double convenience for electrical appliances of all kinds. When installing receptacles, why not install double ones,—77-20's.

Sold by Electrical Jobbers and Dealers, all over

MADE BY

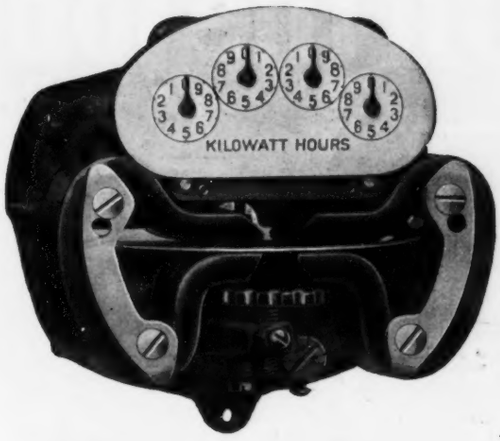
The Cutler-Hammer Mfg. Co.

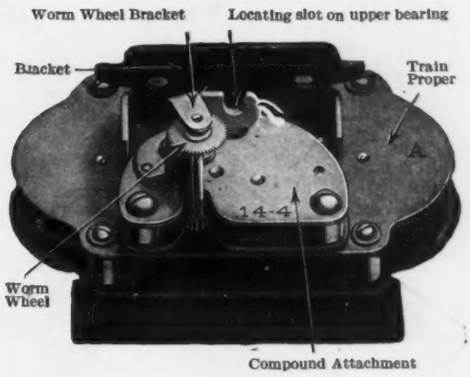
MILWAUKEE, WIS.

Ask for C-H 1919 Specialty Catalog

77-20
77-20
77-20
77-20

NATIONAL
MAZDA
NATIONAL
MAZDA
THE WAY TO
BETTER LIGHT
NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
A
NEW ARRIVAL
IN THE MAZDA FAMILY
The National MAZDA C-4 Lamp
Thousands of homes are waiting to welcome this newcomer, for it represents the most important development in home lighting since the very first MAZDA lamp came to show *the way to better light.*
The National MAZDA C-4 lamp is of gas-filled construction, with a tipless bulb of white glass which conceals the filament, and softens and diffuses the light. It is made in the 50-watt size only.
A double-page advertisement in colors, in the Saturday Evening Post of August 30th, will announce the new lamp to the householders of the country. National MAZDA agents will do well to anticipate the enthusiastic demand that is sure to come.
NATIONAL LAMP WORKS
of General Electric Company
Nela Park, Cleveland, Ohio





Sangamo Meter Trains Are Built Right

THE recording train of a Watthour meter *must* be built right or meter accuracy is impossible. The recording trains of Sangamo meters *are* built right. Friction in the train is reduced to a minimum through accurate meshing of gears and pinions scientifically cut one tooth at a time like all high-grade gears. Corrosion of parts is avoided by using nickel plated brass throughout. In fact the Type "H" meter will show no difference in speed on a very light load whether recording train is on or off.

With Sangamo Meters the recording train *cannot* be attached incorrectly. The entire mechanism is carried on a rigidly formed and swaged brass bracket, accurately located by two dowel pins set in the top face of the grid. This mechanism is held to the grid by two screws very easily accessible from the top when it is desirable to remove the train.

A slot in the worm wheel bracket which engages the upper bearing screw itself insures a positive position and correctly maintained mesh between the worm of the moving element and the worm wheel of the train.

Sangamo Distributing Points:

Springfield, Ill., Main Office and Factory
Birmingham, Ala., Federal Sign System (Electric).
Boston, Mass., Wetmore-Savage Co.
Charlotte, N. C., Electric Supply & Equipment Co.
Chicago, Ill., Electric Appliance Co.
Chicago, Ill., Federal Sign System (Electric).
Chicago, Ill., Sangamo Electric Co.
Cincinnati, O., Federal Sign System (Electric).
Dallas, Texas, Electric Appliance Co.
Denver, Colo., Mountain Electric Co.
Kansas City, Mo., Chas. A. Milbank Co.
Los Angeles, Calif., Sangamo Elec. Co.
Louisville, Ky., Federal Sign System (Electric).
Milwaukee, Wis., Federal Sign System (Electric).
Minneapolis, Minn., White & Converse.
New Orleans, La., Electric Appliance Co.
New Orleans, La., Federal Sign System (Electric).
New York City, Sangamo Electric Co., 50 Church St.
Philadelphia, Pa., Rumsey Electric Co.
Pittsburgh, Pa., Ludwig Hommel & Co.
Rochester, N. Y., H. J. Schlefer & Co.
Salt Lake City, Utah, Sangamo Elec. Co.

The same careful design which insures accurate performance of the train is carried out in all other parts of Type "H." Our nearest agents will be glad to give you details. Write today for bulletin No. 46.

SANGAMO
BUILT LIKE A WATCH

Sangamo Electric Company
Springfield, Illinois

Sangamo Distributing Points:
(Continued)

San Francisco, Calif., Sangamo Elec. Co.
Seattle, Wash., Burton R. Stare Co.
Spokane, Wash., Nixon-Kimmel Co.
St. Joseph, Mo., American Electric Co.
Montreal, Sangamo Electric Co. of Canada, Ltd.
Toronto, Sangamo Electric Co. of Canada, Ltd.

Sangamo Products:

A. C. Rotating Standards.
A. C. Service and Switchboard type Watthour Meters.
Automatic Switches Double Acting.
D. C. Service and Switchboard type Watthour Meters.
D. C. Service and Switchboard type Ampere Meters.
Distant Dial Mechanisms.
Instrument Transformers.
Minimum size type Ampere hour Meters.
Reverse Current Time Limit Relays.
Shunts and Resistance Boxes.
Shunt Trip Circuit Breakers.

On the Job

long after ordinary fuses are scrapped

When you buy a renewable fuse you buy it with the idea that it is going to give *lasting* service. That's the reason you bought the renewable type. You expect it to renew—to live up to its name—to stand the gaff a long time in spite of many blow-outs.

And a fuse that doesn't give you full measure of service in this respect is not renewable in the true sense.

"Union" Renewable Fuse

stands more blow-outs than any other fuse. We are not boasting about it, but merely stating a fact. This is true for several reasons. Here are two:

First: The fusing element does not explode like a hand grenade, straining or burning the tube.

Second: The cap screws onto a *metal ferrule,* which is screwed and riveted to the tube—not onto threaded *fibre* which must inevitably wear and weaken, due to frequent renewals and heat. This metal ferrule also eliminates danger of the fibre tube swelling so the cap can't be removed.

When assembled, the cap, ferrule and tube form a single, rigid, substantial unit—mechanically correct in construction and built for long wear.

"Union" Renewable Fuses comply with standard Underwriters' requirements for cartridge enclosed fuses in rating and short circuit performance. And both the ferrule and knife-blade types of "Union" Renewable Links are interchangeable *with all makes* of standard renewable fuses.

It makes no difference what renewable fuse you have been using, "Union" Renewable Fuses positively will cut your fuse maintenance cost. Sold by dealers in electrical supplies.

Write for booklet.

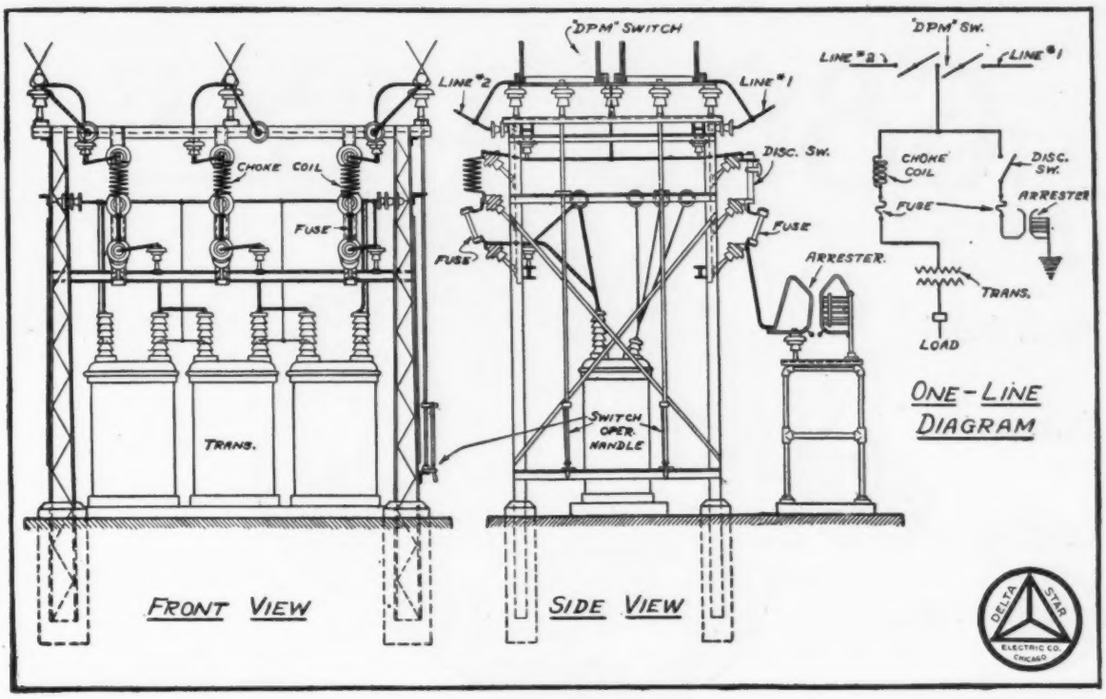
Chicago Fuse Mfg Co.

Oldest and largest manufacturers of Fuses, Electrical Protecting Materials and Conduit Fittings.

Chicago, New York

HIGH TENSION EQUIPMENT

You Will Appreciate **DELTA-STAR Service**



THERE are many users of DELTA-STAR substation equipment who can tell you that DELTA-STAR SERVICE has accomplished a real saving to them—a saving in *first cost* of equipment as well as a *saving* in *cost of upkeep* and alterations due to station growth.

It is a frequent occurrence for a central station or industrial plant to send in a one line diagram showing the supposed requirements for their substation and asking for an estimate on specified equipment. DELTA-STAR engineers have gone over this very carefully and many times have suggested changes which call for less equipment—changes which will give the customer a better substation at less cost than if we had followed the customer's original suggestions.

DELTA-STAR engineers, through years of experience with high tension distribution problems, are competent to advise you as to your requirements. Delta-Star is selling not only Unit Type equipment—*it is also selling permanent substation satisfaction.*

Send us a one line diagram which will outline your requirements. We shall be glad to submit a drawing similar to that shown above —without obligation to you.

Ask for Delta-Star Bulletins.

Delta-Star Electric Company

2433-53 Fulton St., Chicago, Ill.

New York, N. Y., 100 Broadway
Boston, Mass., 76 Pearl St.
Rochester, N. Y., E. & B. Building
Syracuse, N. Y., City Bank Bldg.

DISTRICT OFFICES
Salt Lake, Utah, Walker Bank Bldg.
Toronto, Ont., 67 Yonge St.

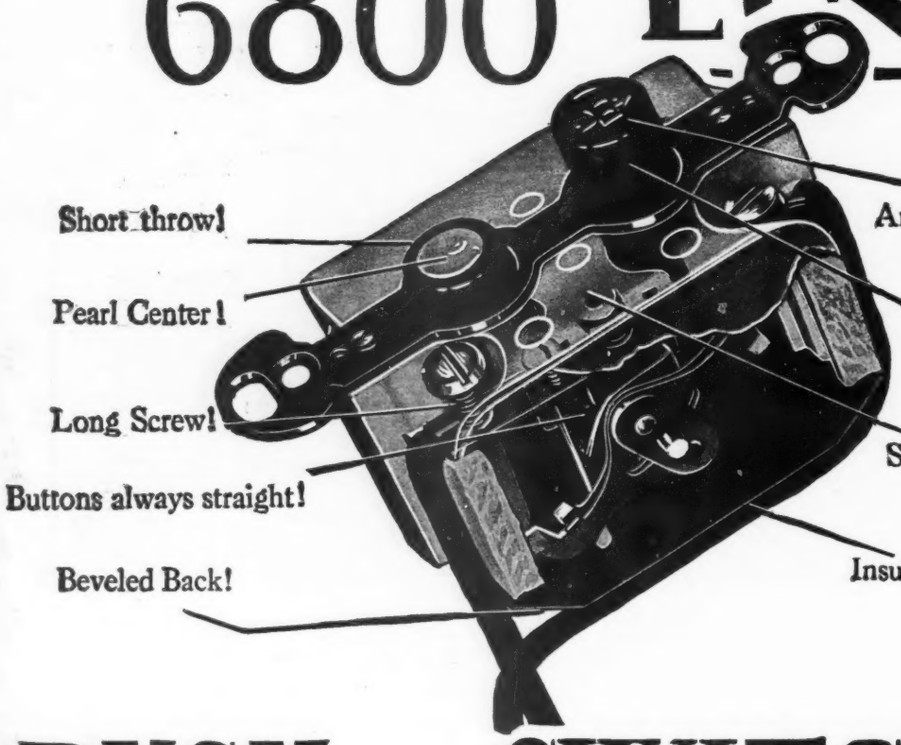
Seattle, Wash., Hoge Building
Philadelphia, Pa., 1231 Arch St.
Denver, Colo., 1633 Tremont St.
Pittsburgh, Pa., Union Arcade

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS

ARROW

6800 LINE



PUSH SWITCHES

Will Last a Lifetime—are Quiet in Operation—have a Smooth Action—give Consistent Satisfaction and Have Everything a Good Switch should have. They sell at a low list but have no superior at any price.

Manufactured by

THE ARROW ELECTRIC CO.

HARTFORD, CONNECTICUT

Chicago New York Boston San Francisco Syracuse

A Hundred Thousand! Nine Million!! Fourteen Million!!!

One Hundred Thousand Farm Lighting Plants—Nine Million Homes wired but for the most part in need of rewiring and refixturing—Fourteen Million Homes Unwired, to say nothing of new building and the opportunities in industrial work of every kind!

There will be a big demand for electrical supplies—the Electrical Jobber is ready to meet it.

Careful selection of stocks—warehouses located right next to the greatest activities in development—familiarity with the needs of the territory covered assure you of reliable material, large assortments, quick deliveries.

Concentrate on the Jobber for the supplies you will need to hold up your end of the Big Business that is coming your way.

Electrical Supply Jobbers Association

Office of the Secretary:

411 South Clinton Street, CHICAGO

Easily the best!

HUBBELL

No. 3190
For temporary or permanent use in any socket

Nos. 3190 and 3191

PULL SOCKET CURRENT TAPS

Combine Pull Socket convenience with Current Tap service. No. 3190 screws into any standard socket—No. 3191 for permanent attachment to the fixture.

Independent control of the lamp while drawing current from side outlet to operate Fan, Vacuum Cleaner or other electrical appliance. Lamp hangs always in correct vertical position and threaded shell takes any standard shadeholder.

Dealers: Here are devices worthy in every way to bear the Hubbell name and trade-mark. They offer great possibilities for counter trade, and while without doubt the best Current Taps for your customers to use, they are by the same token—the best for you to sell. Your Jobber can supply you. Write us for literature.

No. 3191
For permanent attachment to the fixture

HUBBELL

HARVEY HUBBELL, Inc.

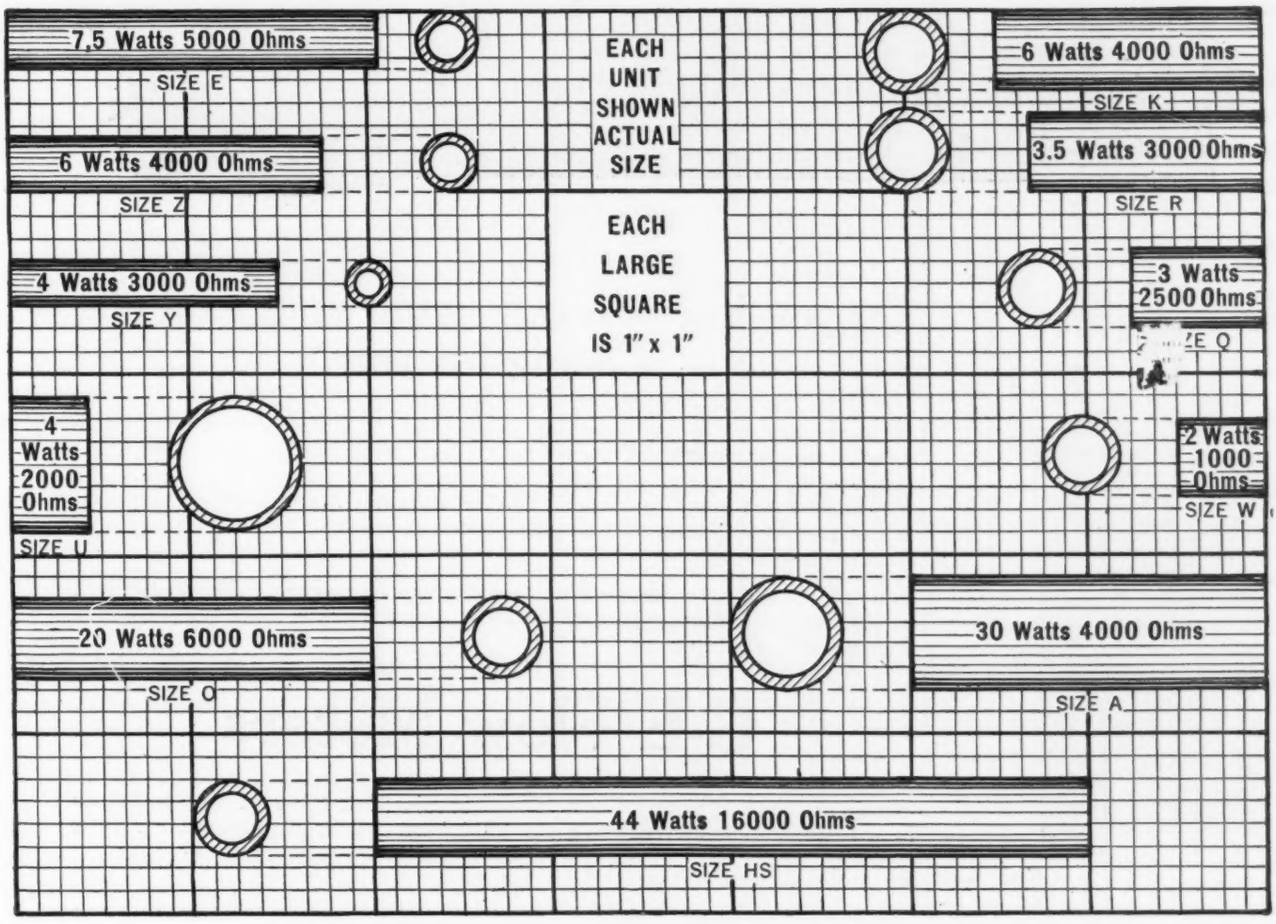
HUBBELL

Bridgeport, Connecticut

New York
Chicago
San Francisco
Atlanta
Denver

A Few "Vitrohm" Resistor Units

Do you want one—FREE?



If none of these units meet your requirements, tell us your problem—the experience of our engineering staff is at your disposal.

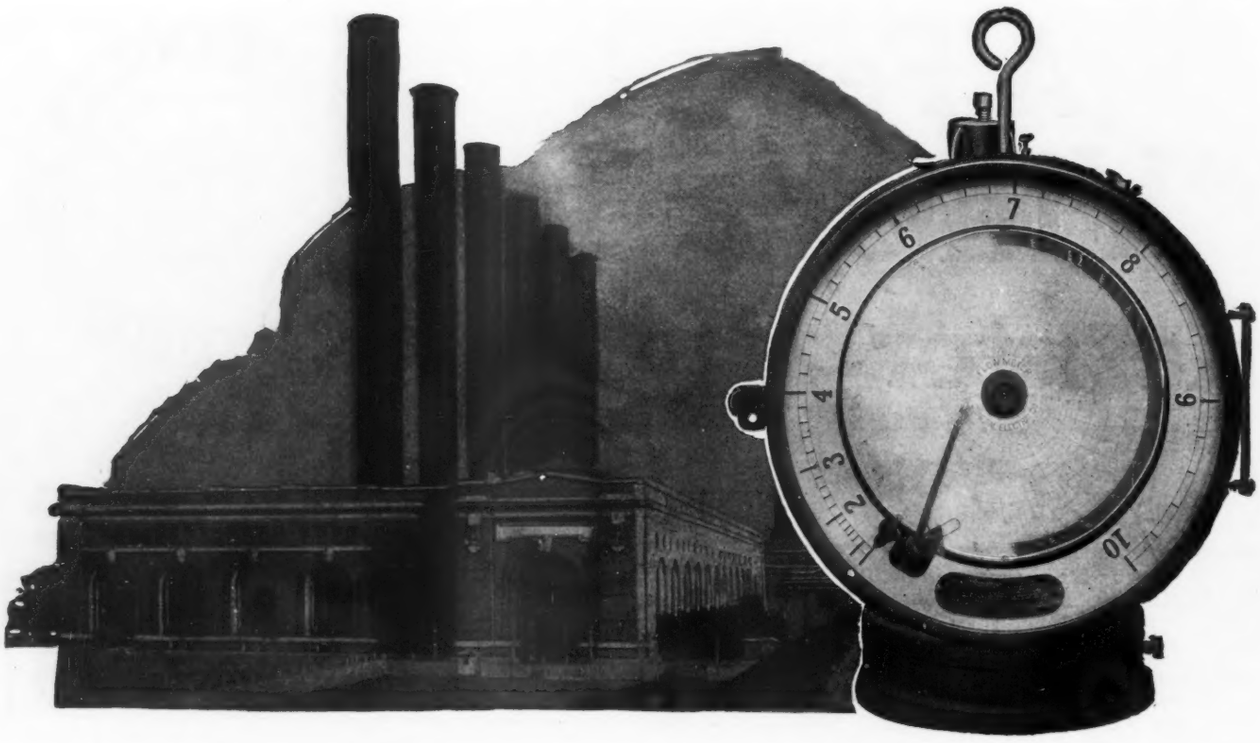
Ward Leonard Electric Company

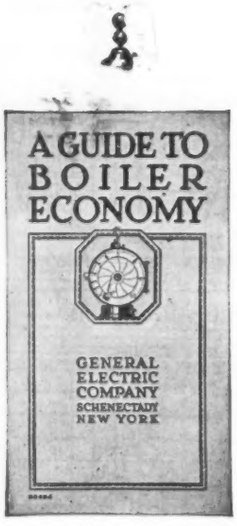
Mount Vernon, New York

Westburg Engineering Co.—Chicago
William Miller Tompkins—Philadelphia
Morse Engineering Co.—St. Louis
Electric Material Co.—San Francisco

Walter P. Ambos Co.—Cleveland
Sperry & Bittner—Pittsburgh
Electrical Specialties Co.—Detroit

2019





Do you know exactly what your coal pile is doing for you?

This country no longer tolerates guesswork in power plants. The successful superintendent of an efficient plant does not guess — he knows. That's why the plant is efficient and the superintendent successful. He knows how much coal is burned, how much water is evaporated, how each boiler unit is steaming and how much steam is taken by the different departments and processes.

Much of this data must be based on the measurement of feed water and steam and in obtaining this information no meters are more accurate and continually reliable than

G-E Flow Meters

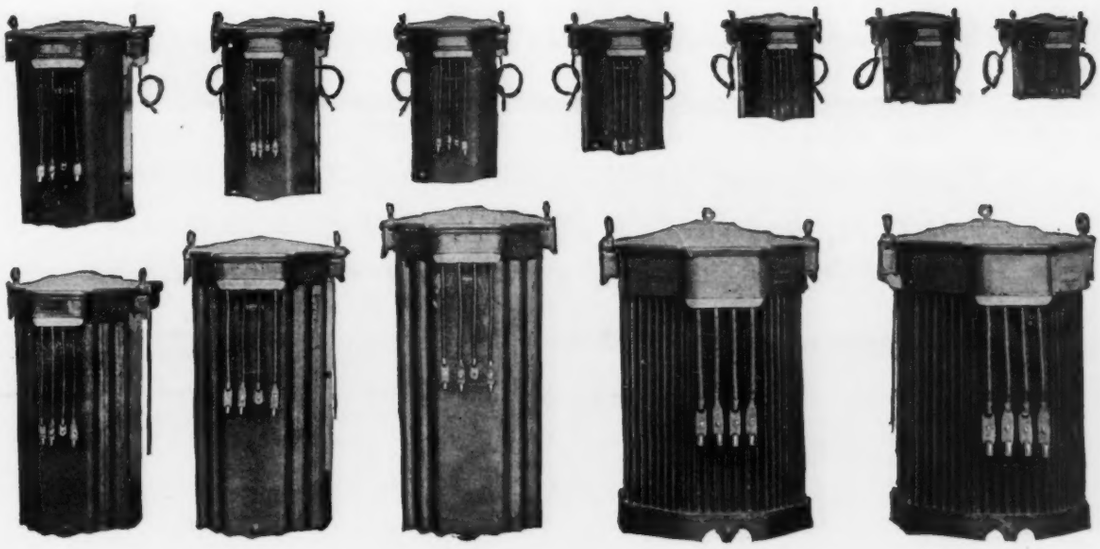
There are several types of G-E Flow Meters. Our Flow Meter Specialists will assist you in determining the best Flow Meter Equipment for your plant.

Write for the Booklet "A Guide to Boiler Economy" and Bulletin 46501-*B.*

General Electric Company

General Office Schenectady, N.Y.

34C-9



Transformers of Standardized Ratings Save in Many Ways

The use of standard transformers means economy, better service and conservation of man-power. G-E transformers are available in all of the standard ratings recommended by the National Electric Light Association.

Our nearest office will be glad to co-operate with you in the application of these standard transformers to your system.

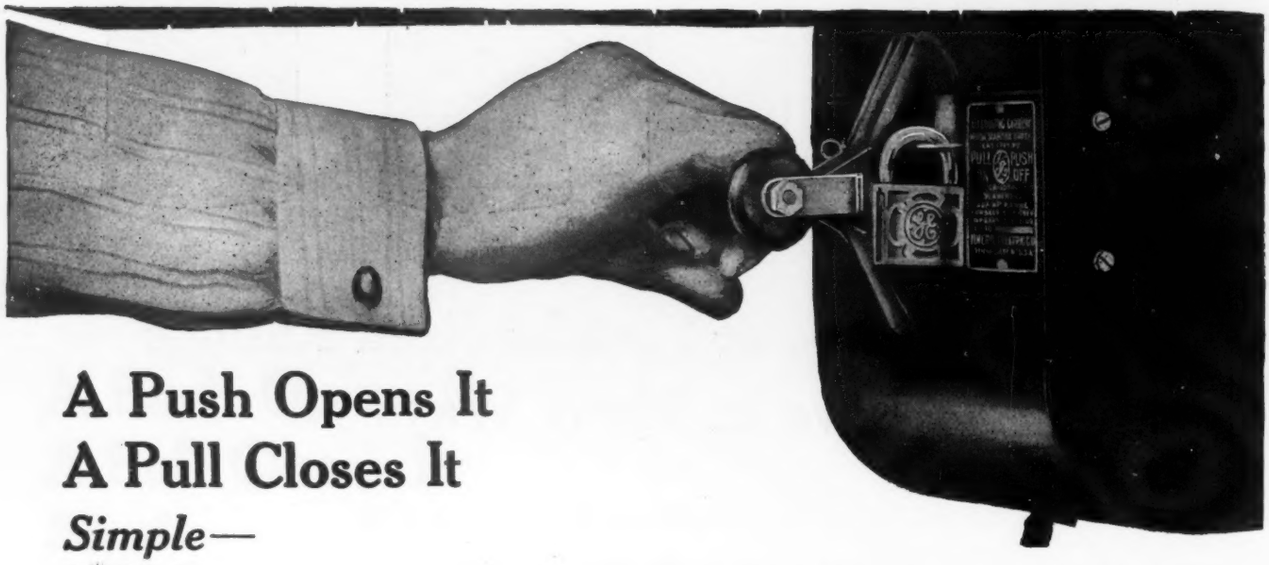
TYPE H—THE STANDARD OF QUALITY

General Electric Company

General Office Schenectady, N.Y.

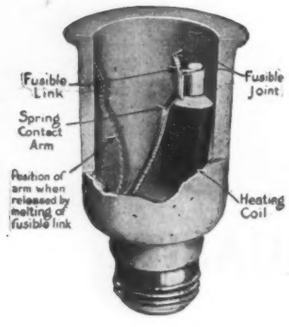
33A-5

There are many inexpensive "Safety" Starting Switches, but there's just one that also provides Time Limit Overload Protection—the CR 1038.



A Push Opens It
A Pull Closes It

Simple—
Safe—
Sure—



Simple starting and economical protection for small A-C motors up to 5 hp. are combined in the CR 1038 Motor Starting Switch.

The momentary high-starting current or overloads for short periods will not injure the motor, but will blow any ordinary fuse of a size that would safeguard the motor against prolonged overload.

The time lag feature of the protective plugs furnished with CR 1038 switches assures, not only protection, but continuity of service in spite of brief overloads.

The safety features of the CR 1038 are also unique—an accidental push opens the switch—cover cannot open if switch is closed—switch may be locked open when not in use.

The fusible link is the only supply part needed.

The link costs about as much as a postage stamp.

Approved by Underwriters—thousands in use—more thousands on the way.

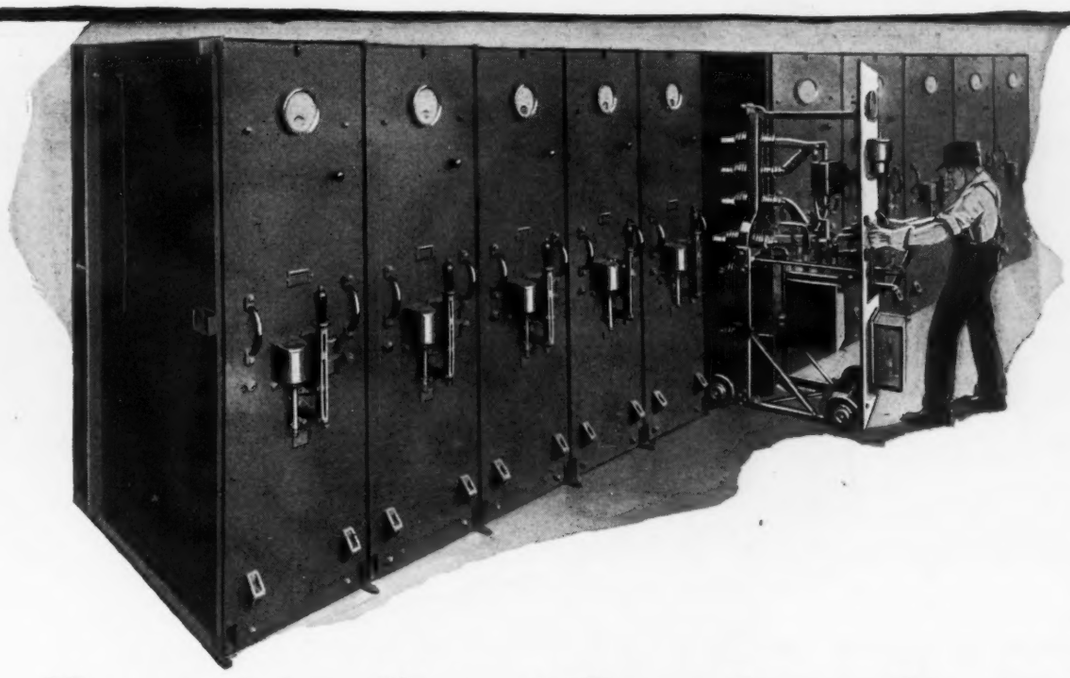
Can be purchased from G-E Agents.

General Electric Company

General Office Schenectady, N.Y.

43A-38

A switchboard that will prevent little troubles becoming great losses is worth building and standardizing



How much is uninterrupted operation worth to you?

The profit of many operations and processes depends on their being continuous. Interruptions dislocate schedules, disorganize departmental operations and start other difficulties.

To prevent interruptions, originating at the switchboard, the remedy is to use G-E Truck Switchboard Units. They reduce the probability of interruptions to the minimum. If an interruption does occur, substitution of a spare truck of the proper capacity makes it possible to maintain service which, in most cases, can be regarded as practically continuous.

These movable trucks, as illustrated, carry all the instruments, switching and protective devices. By mounting this equipment on a truck, which can be withdrawn only when this apparatus is dead, electrically, inspection is easy and safe. Complete enclosure of all live current-carrying parts within the steel compartment affords personal safety at all times and reduces fire risk.

Consult the G-E Switchboard Specialist in your vicinity. Write our nearest office.

54-19

G-E Truck Type Switchboard Units

General Electric Company

General Office Schenectady, N.Y.

The same far-reaching publicity that has popularized MAZDA Lamps is being consistently applied to G-E Motors

Advertising That Moves Your Stock

The two-color illustration above will compel attention to the G-E Motor advertising in the Saturday Evening Post of June 28th and Good Housekeeping for July.

It is a *washing machine* advertisement. It will move *all* washing machines —particularly G-E motored washing machines.

All G-E advertising is designed to move *all* your stock, to keep it moving, to quicken your turn-over.

This advertising assistance—together with quick-action dealer helps and tie-in window displays—makes happy business men of dealers who sell products "equipped with General Electric motors."

★

G-E motors

55 B-18

—from the Tiniest to the Mightiest

GENERAL ELECTRIC COMPANY

The New Milk-white tipless MAZDA C-4 Lamp

ANOTHER epoch-making attainment for MAZDA Service! This milk-white *tipless* gas-filled Mazda C-4 lamp is the culmination of years of endeavor to produce mellow, glareless, efficient, white light and to remove the tip. One size only—50 watt,110 to 125 volts.

The outstanding characteristics of this lamp make it *the* lamp for nearly all but industrial lighting. Without change of equipment, Mazda C-4 lamps may be substituted for standard, clear Mazda B lamps of 40, 50, or 60 watts.

The efficiency of the Mazda C-4 lamp is somewhat higher than that of the 50-watt clear Mazda B lamp.

Orders for Edison Mazda C-4 lamps will be acceptable after July 1, 1919.

EDISON MAZDA

53-47

EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY

KERITE

AN INVESTMENT

When you put your money into KERITE you make an investment in service. You do more than buy conductors, insulation and protection. You obtain the best possible combination of the most desirable qualities in permanent form.

KERITE remains long after the price is forgotten.

KERITE INSULATED WIRE & CABLE COMPANY

General Offices, 30 Church Street, New York Factory and Office, Peoples Gas Building, Chicago

PARANITE

RUBBER COVERED WIRES & CABLES

If it's PARANITE it's right

More than meets code requirements

Underground, Aerial, Submarine and Inside Use, Telephone, Telegraph, Fire Alarm, Electric Light and Power Wires and Cables

THE BEST FOR EVERY PURPOSE

INDIANA RUBBER & INSULATED WIRE CO.

JONESBORO, IND.

CHICAGO BRANCH:
210 S. DESPLAINES ST.

EASTERN REPRESENTATIVES:
THOMAS & BETTS CO. 105 HUDSON ST., N.Y.

OKONITE

TRADE MARK
REG. U. S. PATENT OFFICE

When you get the habit

of using OKONITE Insulated WIRES and CABLES, you have met *Success* more than half way.

THE OKONITE CO.

Passaic, New Jersey

Central Electric Company, Chicago, Ill., Gen'l Western Agents
F. D. Lawrence Elec. Co., Cincinnati, O.
Pettingell-Andrews Co., Boston, Mass.
Novelty Elec. Co., Philadelphia, Pa.

3

SIMPLEX STEEL TAPED CABLES

Hundreds of towns and cities today use SIMPLEX Steel Taped Cables to distribute current for street lighting. Satisfactory service is assured because the cables are designed for just this type of underground distribution.

Low cost of installation and maintenance make them desirable from an investment standpoint. Streets need not be torn up; pipes, manholes and catch basins need not be moved, and no conduit is required.

SIMPLEX WIRE & CABLE Co

MANUFACTURERS

201 DEVONSHIRE ST. BOSTON

CHICAGO SAN FRANCISCO

A large company of pleasant helpful well-mannered salesmen

Adapted from EARNEST ELMO CALKINS
in the QUALITY GROUP

CONSIDER what is offered in the advertising pages of the carefully edited business paper.

Here are salesmen, silent but eloquent, waiting their turn, full of information—for you.

They wait upon you. You receive them at your convenience in your office — in your easy chair, or riding to and fro in time otherwise lost.

They are vouched for. None are admitted whose credentials are not satisfactory.

What they say is in permanent printed form. It remains a witness of the contract between you and the maker of the goods.

The advertising department is a pleasant guide through the industry, personally conducted tours with short illustrated lectures on desirable things that are for sale.

Or it is a reference book, a directory, a guide, to be consulted when you have some particular need.

Or a history of the fine art of supplying your wants, a bird's-eye view of all the new and old things manufacturers have thought up and made for you.

What a lot of looking around and correspondence these advertisements save you! You have become so used to their service you forget how convenient that service is, just as you accept the telephone, the vacuum cleaner or the electric light.

A great deal of anxious thought went into the making of these advertisements. They are addressed to you. Their whole aim is to please you, to interest you, to tell you something that will give you pleasure and profit and satisfaction.

They are advance salesmen who visit you in your office or in your home, to give you the earliest word about things you need or want, to help you make up your mind, so that you can buy quickly and with greater certainty and knowledge.

Electrical World

"The Voice of the Industry"

Directory of Engineers

W. G. ABBOTT, Jr.
Research Engineer

Processes, Inventions, Special Machinery — Electrical, Chemical, Mechanical

Laboratory, Wilton, N. H.

THE ARNOLD CO.
Engineers, Constructors
Electrical—Civil—Mechanical
105 So. La Salle Street, Chicago

WILLIAM A. BAEHR
Consulting Engineer
Gas and Electric Plants
Design, Construction and Operation
Valuations and Reports
People's Gas Building, Chicago

Barclay Parsons & Klapp
Consulting Engineers
General Engineering, Design, Construction, Operation, Traffic Surveys, Appraisals, Examinations and Reports
Electro-Metallurgical Plants, Designed, Built and Operated
60 Wall Street, New York

ROGERS BIRNIE, A. S. M. E.
WILFORD J. HAWKINS, A. S. M. E
JOHN N. WATSON, Accountant.
Consulting Engineers and Accountants
Industrial Manufacturing Organizations
Processes, Bankers Reports, Accounting, Ordnance Construction and Ballistic Problems.
511 Fifth Avenue, New York.

H. M. BYLLESBY & CO.
INCORPORATED
Chicago, Continental & Commercial Bank Bldg., New York, Trinity Bldg.

Purchase, Finance, Construct and Operate Electric Light, Gas, Street Railway and Water Power Properties. Examinations and Reports, Utility Securities Bought and Sold.

E. W. CLARK & CO.
MANAGEMENT CORPORATION
ENGINEERS
Power Plants, Electric Power Transmission and Industrial Applications.
Huntington Bank Building, Columbus, Ohio.

HUGH L. COOPER & CO.
General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
101 Park Ave. New York

ELECTRICAL TESTING LABORATORIES
Electrical and Mechanical Laboratories
Tests of Electrical Machinery, Apparatus and Supplies. Materials of Construction. Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
80th St. and East End Ave., New York

FOWLE & CRAVATH
Engineers
Electrical—Illuminating—Mechanical
Monadnock Block
Chicago
Frank F. Fowle — James R. Cravath

FARGO ENGINEERING CO.
Jackson, Michigan
HYDRAULIC ENGINEERS
Specialize in the Design of Power Plants and DAMS ON SOIL FOUNDATIONS

FORD, BACON & DAVIS
Engineers
115 Broadway
New York
New Orleans — San Francisco

Gannett, Seelye & Fleming
ENGINEERS
Farley Gannett, Theodore E. Seelye, Samuel W. Fleming, Jr.
Civil, Sanitary, Hydraulic and Electrical Engineers. Reports, Appraisals, Design and Supervision of Construction.
Harrisburg, Pa. 204 Locust Street — Erie, Pa. Palace Hardware Bldg.

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Consulting Engineer
Designs, Estimates, Specifications and Reports on Engineering Structures, Self-supporting Stacks, Coal Handling Machinery, Intake Tunnels for Power Stations, Heavy and Complicated Foundations and Caissons.
Valuation, Appraisals and Financial Reports on Public Utility Properties.
1590 Old Colony Building, Chicago

NEVIL MONROE HOPKINS, PH. D.
Research Engineer
Fel. Am Inst. Elec. Engrs. Mem. Am. Soc. Mech. Engrs.
Registered Attorney
United States Patent Office
Telephone North 5547
2128 Bancroft Place, Washington, D. C.

W. J. HUDDLE & CO.
Successors to
Sloan, Huddle, Feustel & Freeman
Consulting Engineers
Valuations, Reports, and Rate Investigations of Public Utility Properties
1745 Conway Building, CHICAGO

ILLINOIS TESTING LABORATORIES
Industrial and Power Plant Tests Consulting; Design and Development of Electrical Devices; Instrument Testing Work.
Madison Terminal Bldg., Chicago, Illinois.

IVES & DAVIDSON
ENGINEERS
Construction—Management—Valuation
PUBLIC UTILITY PROPERTIES
Rate Revision Cases Before Public Service Commissions
61 Broadway, New York

LESLIE-STEVENS CO.
Incorporated.
Power and Industrial Plants
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KW.		Speed
1 25	Gen. Electric, 240 v.	1800
1 50	Allis-Chalmers, 240 or 480 v.	1200
1 75	Westinghouse, 240 or 480 v.	1200
1 75	Gen. Elec. ATB rev. field, 2300 volt.	900
1 90	Electric Machinery revolving field, 2300 volt.	1200
1 100	Western Elec revolving field, 2300 volt.	600
1 125	Allis-Chalmers, 240 or 480 v.	900
1 125	Electric Machinery Co. revolv. field, 440 volt.	720
1 150	Westinghouse, revolving field, 1100 or 220 volt.	900
1 150	Westinghouse, rev. field, 2500 volt, direct connected to Harrisburg-Fleming Horiz. self-oil side-crank engine	257

220-VOLT D. C. GENERATORS

KW.		Speed
1 2	Sprague-Lundell	1250
1 15	Garwood (C. & C.), MP, comp, 125-250 v., 3-wire, double commutator, D. C. DeLaval single stage non-condensing turbine	2000
1 15	Peerless, MP	1200
1 20	Sprague, direct-connected to DeLaval single-stage steam turbine, for 150 lb. steam pressure	2000
1 25	Northern	1050
1 25	Fairbanks-Morse	725
1 35	Allis-Chalmers	725
1 35	Western Elec., to Chuse engine	209
1 40	Sprague, 125-250 v., 3-wire	1650
1 50	C. & C.	640
1 55	Ft. Wayne, 125-250 v., 3-wire	950
1 56¼	Northern, type L	500
2 62½	Allis-Chalmers	450
1 75	Morgan-Gardner	725
1 100	Allis-Chalmers	850
1 100	Westinghouse	650
1 110	Crocker-Wheeler	720
2 125	Allis-Chalmers	850
2 150	Ft. Wayne, interpole	650
1 150	Morgan-Gardner	550
1 225	Crocker-Wheeler, 6-pole	450
1 225	Northern, 8-pole	360

125-VOLT D. C. GENERATORS

KW.		Speed
1 3	Triumph, Sturtevant vertical steam engine	400
1 3¾	Westinghouse	1600
1 4	Crocker-Wheeler	1500
1 6½	Fairbanks-Morse	1700
1 7½	Fairbanks-Morse	1650
1 8½	Roth	1500
1 9	Northern	1300
1 9	Fairbanks-Morse	1100
1 10	Westinghouse	1600
1 12½	Westinghouse, type SK interpole, with fly wheel pulley for gas engine operation	1350
1 12½	Northern, interpole	1300
1 12½	Triumph	1100
1 15	Hobart	1450
1 15	National	1150
1 17½	National	1350
1 17½	Triumph	850
1 21½	Milwaukee	725
1 25	Northern	1000
1 25	Gen. Elec.	825
1 40	Gen. Elec., direct-connected Ideal, horizontal engine	300
1 50	Crocker-Wheeler	450
1 50	Gen. Elec., direct-connected to Erie-Ball horizontal engine	280
1 65	Crocker-Wheeler	625
1 100	National, 6-pole, type MB, 4000 light	615
1 100	Westinghouse, MP, 4000 light, direct-connected to 11x18x13 in. Harrisburg tandem-compound engine	275

110-125-VOLT MOTORS

H.P.		Speed
1 2	Gen. Elec.	1650
1 2	Western Elec.	1225
1 2	Akron	1100
2 2	Roth	1100
1 2	Sprague-Lundell, series full load speed.	1025
2 2½	Watson	980
1 2½	Sterling	750
4 2½	Van Dorn & Dutton portable electric drills, taking Morse taper-shank drills up to 2 in.	300
1 3	Fairbanks-Morse	1650
1 3	Western Elec.	1150
1 3	Roth	1150
1 3	Northern	1125
4 3	Gen. Elec.	1100
1 3	Watson	1050
1 3½	Lincoln	1350
1 3½	Sprague-Lundell, 6-pole, comp., printing-press motor, with C-H Bull, 4140 Carpenter type comp. reversible printing-press controller, for both armature and field control	168
1 4½	Crocker-Wheeler, variable speed	580-1160
1 5	Western Elec.	1675
1 5	Northern	1650
2 5	Gen. Elec., interpole	1650
1 5	Roth	1100
1 5	Gen. Elec.	1000
1 5	Ft. Wayne	975
1 5	Westinghouse	975
2 5	Western Elec. comp., totally encl. hoist-motors, new, with Ward-Leonard reversible panel-type controllers	900
2 5	Westinghouse	820
1 5½	Gen. Elec.	1750
2 6	Western Elec.	1000
1 6	General Elec., variable speed	460-2600
1 7	Sprague	235
1 7½	Roth	1550
1 7½	Allis-Chalmers	1440
1 7½	Gen. Elec.	1400
2 7½	Fairbanks-Morse	1325
1 7½	M. & O.	1250
1 7½	Barriett	1000
1 7½	Western Elec.	540
1 7½	Triumph, MP	250
1 10	Roth	1300
1 10	Fairbanks-Morse	1300
1 10	Gen. Elec., interpole	1150
1 10	Watson	1050
1 10	Fairbanks-Morse, interpole	900
2 10	Ideal, MP, comp., elevator motors	900
1 10	Western Elec.	575
1 12	Western Elec.	950
1 12	Sprague-Lundell	850
1 13	Jenney	1050
1 15	Allis-Chalmers	1390
1 20	Westinghouse	1700
1 20	Triumph	675
1 30	Gen. Elec.	675
1 75	Crocker-Wheeler	550

220-250-VOLT MOTORS

H.P.		Speed
1 1/3	Westinghouse	1725
1 3/8	U. S. Elec. Tool Co. portable electric drill, taking taper-shank drills up to ⅝ in.	200
1 1/2	Western Elec.	1725
1 1/2	Westinghouse, full load speed	700
1 3/4	Westinghouse	1500
1 1	Roth	2100
1 1	Crocker-Wheeler	1600
8 1	Western Elec.	1300
1 1	Western Elec., "Yankee" twist-drill grinder	1300
2 1	Gen. Elec.	1275
1 1	Northern	1250
1 1	Watson	1200
5 1	Western Elec.	1150
1 1	Jenney, MP, double-reduction, back-geared	1700-40
1 1½	Westinghouse, type SK, comp, interpole	900
1 2	Gen. Elec., comp., interpole	1700
1 2	Fairbanks-Morse	1650
1 2	Gen. Elec., comp., back-geared	1100-275

220-VOLT MOTORS

H.P.		Speed
1 2½	Ft. Wayne	1400
2 2½	Thompson-Ryan, interpole	1225
1 2½	Milwaukee	1025
1 2½	Gen. Elec., type CE, variable speed	1050-2100
1 2½	Crocker-Wheeler	875
3 2½	Allis-Chalmers, variable speed	490-650
1 3	Western Elec.	1950
1 3	Allis-Chalmers	1875
1 3	Westinghouse	1800
1 3	Gen. Elec.	1650
2 3	Gen. Elec.	1650
1 3	Watson	1650
1 3	Holtzer-Cabot	1600
2 3	Bartz-Wygand & Brown	1525
3 3	Westinghouse	1500
1 3	Crocker-Wheeler	1437
2 3	Fairbanks-Morse	1350
1 3	Watson, MP	1200
1 3	Gen. Elec.	1050
1 3	Thompson-Ryan, interpole	730
1 3½	Gen. Elec.	750
1 3½	Westinghouse, type SK, comp., interpole, variable speed	375-1500
1 5	Crocker-Wheeler	1850
1 5	Jenney	1750
1 5	Fairbanks-Morse	1700
1 5	Peerless	1425
1 5	Gen. Elec.	1100
1 5	Westinghouse,	975
1 5	Gibbs	935
2 5	Crocker-Wheeler	900
1 5¼	Westinghouse	1500
1 6	Bartz-Wygand & Brown	1475
1 6	Willey	1275
1 6	Fairbanks-Morse	1100
1 6	Browning	600
1 7	Westinghouse	950
1 7½	Westinghouse	1800
1 7½	Colonial	1575
1 7½	Watson	1350
1 7½	Browning	875
2 7½	Crocker-Wheeler	875
1 7½	Sprague-Lundell, comp., printing-press motor	140
1 10	Robbins & Myers	2100
1 10	Allis-Chalmers	900
1 10	Cincinnati	900
2 10	Holtzer-Cabot	900
1 10	Fisher	850
3 10	Fairbanks-Morse	750
1 10	Crocker-Wheeler, variable speed	720-1200
1 10	Gen. Elec.	650
1 12	Western Elec.	1200
1 15	Ft. Wayne	1250
1 15	Peerless	975
1 15	Gen. Elec., interpole	925
1 15	Western Elec.	880
1 15	Jenney	850
1 15	National	725
1 15	Gen. Elec.	690
1 15	Triumph	520
1 15	Northern	400
3 17	Crocker-Wheeler, variable speed	700-1400
1 20	Jenney	1000
1 20	Jantz & Leist	900
1 20	Crocker-Wheeler	700
1 20	Northern	675
1 20	Western Elec.	675
1 20	Lincoln	540
1 25	Crocker-Wheeler	750
1 25	Allis-Chalmers	700
1 25	Gen. Elec.	550
2 25	Westinghouse, railway type, series, crane or hoisting	500
1 25	Westinghouse	400
1 30	Northern	900
1 30	Fairbanks-Morse	650
1 30	Westinghouse	600
1 30	Westinghouse, type SK, comp., interpole	600
1 30	Westinghouse	575
1 35	Westinghouse, railway type, series, crane or hoisting motor	550
1 40	Northern	550
1 40	Westinghouse	500
1 45	Allis-Chalmers	650
1 50	Westinghouse	550
6 50	Westinghouse	525
1 65	C & C	525
1 75	Western Elec.	500
1 75	Northern	450
1 75	Northern	400
4 75	Allis-Chalmers	325
1 100	Morgan-Gardner	650
3 150	Allis-Chalmers	650

220-VOLT MOTORS (Continued)

H.P.		Speed
1 200	Ft. Wayne, G, 6-pole, comp., interpole	500
1 200	Ft. Wayne, comp. interpole	500

500-VOLT

H.P.		Speed
1 1/4	Roth, totally enclosed, shunt	1250
1 1/2	Westinghouse, type R, shunt	1375
1 1	Gen. Elec., type CQ	1400
1 1	Gen. Elec., type CA	1300
1 1	Fairbanks-Morse, MP	1300
1 1½	Commercial	1700
1 1½	Fairbanks-Morse, MP	1700
1 2	Commercial	1100
1 3	Crocker-Wheeler, form L	1900
1 3	Jenney, MP	1725
1 5	Ft. Wayne, type MP	1500
1 6	Western Elec., old style bipolar, type GI	1100
1 7½	Gen. Elec., type CE	1650
1 15	Ft. Wayne, MP, type EL	1450
1 15	Northern, MP, vertical, on tripod	460
1 15	Northern, MP, type B	460
1 20	Jenney, MP, comp	1250

LOW VOLTAGE GENERATORS

Capacity		Speed
1	11½ ampere Roth, 65 volt, shunt	2400
1 25	ampere Western Elec., 30 volt, shunt	1750
2 25	ampere Western Elec., 42 volt, shunt	1750
2 30	amp. Northern, shunt, 35 volt	2000
1 40	ampere Colonial, MP, shunt, 30 v.	1500
1 50	ampere Sterling, MP, shunt, 60 v.	1500
1 58.3	amp. Fairbanks-Morse (3½ KW), type CP, comp., interpole, 60 v.	1850
1 60	ampere Browning, MP, shunt, 25 volt (or 30 amperes, 50 volts), double commutator generator	2000
1 65	ampere Western Elec.., shunt, 8½ volt	1750
1 100	amp. Western Elec., 30 volt, MP, shunt	1200
1 170	amp. Allis-Chalmers, 30 volt, shunt, d. c. generator direct-connected to 7½ H. P., 220 v., MP, d. c. motor, with starter (dynamotor)	1200
1 180	amp. Phoenix, MP, comp., 6 v., type P, form A	1500

LOW VOLTAGE MOTORS

H.P.		Speed
3 1/8	Western Elec., comp., 32 volt	1725
1 1/6	Western Elec., comp., 32 volt	1725
7 1/4	Western Elec., 32 volt	1725
1 1/4	Western Elec., comp., 32 volt, new	1140

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2 150	KW. Gen. Elec., rotary converters, 3-phase, 25 cycle, 372 v. a. c. to 600 v. 250 amp. d. c.; each with 3-60 KW. type H 25 cycle 6600-375 v. oil-cooled indoor type transformers; also both a. c. and d. c. control panels with instruments 750
1 150	KW. Morgan-Gardner, 6-pole, 220 v., compound, d. c. generator, direct coupled by insulated flexible coupling on wooden sub-base to 250 H. P. Westinghouse, type CX, 220 or 440 volt, 3-phase, 60 cycle induction motor, with rheostat for generator and oil starting compensator for motor 580

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1—125-kw. Westinghouse, 8-pole, compound wound Generator, 280-r.p.m., direct connected to 14 and 24 x 14 Westinghouse compound engine
2—60-kw. Crocker-Wheeler, 275-r.p.m. Generators direct connected to 13x12 Buffalo Forge Engine.
1—37½-kw. Westinghouse, 320-r.p.m., compound wound Generator, direct connected to 10 and 18 x 10 Westinghouse engine

125 Volt Direct Current, Direct Connected Units

1—62½-kw. Westinghouse, 329-r.p.m. Generator direct connected to 10 and 18 x 10 Westinghouse engine
1—60-kw. G. E. 118/120-v., 6-pole, compound wound Generator, 280-r.p.m., direct connected to 12½ x 14 Watertown horizontal right-hand engine
1—50-kw. Western Electric, 125-v., 6-pole, compound Generator, direct connected to 10 x 11 Russell engine
1—35-kw. Westinghouse, 310-r.p.m. Generator direct connected to 11 x 10 Ames engine
1—30-kw. Sturtevant, 125-v., 6-pole Generator 325-r.p.m., direct connected to 9 x 9 Sturtevant engine
1—30-kw. Westinghouse, 110-v., 6-pole Generator, 325-r.p.m., direct connected to 10 x 12 Harrisburg horizontal engine
1—30-kw. Western Electric, 115/125-v., 6-pole, compound wound Generator, Erie Ball center crank engine

250 Volt Generators

1—300-kw. Sprague Lundell, 470-r.p.m 3 bearing
3—250-kw. Westinghouse, 450-r.p.m. 3 bearing
1—150-kw. Westinghouse, 550-r.p.m.
1—150-kw. National, 575-r.p.m.

Gas or Gasoline Unit

1—5-kw., G. E. 3-wire, 125/250-v. Generator, 750-r.p.m., direct connected to G. E., 4-cylinder gas engine, all complete
1—5-kw. General Electric, 125-v., 750-r.p.m. Generator, direct connected to 4-cylinder gas engine

125 Volt D. C. Generators

2—150-kw. Westinghouse, 475-r.p.m.
1—100-kw. General Electric, type MP, 650-r.p.m.
1—50-kw. General Electric, CL, 600-r.p.m.
1—45-kw. C. & C., type SL, 920-r.p.m.
1—45-kw. General Electric, MP, 975-r.p.m.
1—40-kw. Wood, 1000-r.p.m.
1—25-kw. Crocker-Wheeler, 875-r.p.m.
1—25-kw. General Electric, 1100-r.p.m.
1—22-kw. Lincoln, 775-r.p.m.
1—18½-kw. American Engine Co., 1050-r.p.m.
1—18-kw. Bullock, 1400-r.p.m.
1—15-kw. Western Electric, 1010-r.p.m.

125 Volt D. C. Motors

1—90-hp. General Electric, 500-r.p.m.
1—60-hp. Holtzer Cabot, 615-r.p.m.
1—50-hp. Sprague, 540-r.p.m.
1—30-hp. Fisher, 600-r.p.m.
1—25-hp. General Electric, 580-r.p.m.
1—25-hp. Peerless, 710-r.p.m.
1—25-hp. Crocker-Wheeler, 1025-r.p.m.
1—25-hp. General Electric, 650-r.p.m.
1—20-hp. Western Electric, 900-r.p.m.
1—20-hp. General Electric, 1600-r.p.m.
2—20-hp. General Electric, 925-r.p.m.
4—20-hp. General Electric, 1040-r.p.m.
1—15-hp. General Electric, 1000-r.p.m.
2—15-hp. General Electric, 690-r.p.m.
1—10-hp. General Electric, 115-v., 1250-r.p.m.
1—10-hp. General Electric, 115-v., 1100-r.p.m.
1—10-hp. Crocker-Wheeler, 115-v., 1000r.p.m.
1—10-hp. General Electric, 115-v., 650-r.p.m.

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250 Volt D. C. Motors

2—20-hp. Northern, 950-r.p.m.

500 Volt Motors

1—200-hp. Westinghouse, 500-r.p.m.
1—50-hp. General Electric, 900-r.p.m.
1—40-hp. Westinghouse, 660-r.p.m.
1—15-hp. General Electric, 1200-r.p.m.

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1—300-kw. Westinghouse, 3-ph., 60-cy., 370-v. A.C., 575-v., D.C., 600-r.p.m.
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450-kw. G. E., with Allis Corliss C.C. Engine, $8500
400-kva. Westinghouse with Erie Ball, 4 valve engine, $12,000.
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130-kw. Wghse., with Russell, 4-valve engine, $3000
125-kw. G. E., with Harrisburg, 4-valve engine, $3750.
100-kva. Fairbanks, with Lycoming engine, $2350.
100-kva. Westinghouse, with Ames Engine, $2500
2—100-kva. Wghse., with Ballwood tandem engine, $1750.
50-kva. Westinghouse, with Erie Ball Engine, $1500.

BELTED A. C. ALTERNATORS

Kw.	Generator	Speed	Price
200	G. E.	600	$1500
200	Allis-Chalmers	900	1400
150	Elec. Mchy.	720	1000
120	Westinghouse	900	900
115	Allis-Chalmers	900	900
100	W. E.	600	800
20	Wagner	1200	400

ENGINES

Cylinder	Make	Type	Price
15 x 14	Ideal	Auto	$350
14 x 24	Murray	Throttling	200
13½ x 15	Taylor	Auto	200
10 x 12	Ames	Auto	175

GAS AND OIL ENGINES

Hp.	Make	Gas or Oil	Price
125	Wghse.	Gas or gasoline	$1200
20	Nash	Gas	350
18	Metz & Weiss	Oil	400
7	Priestman	Oil	100
5	Fairbanks	Gas	75

60-CY. A. C. MOTORS

Hp.	Make	Phase	Volt	Speed	Price
20	G. E.	3	550	1200	275
3— 5	Wghse.	3	550	1700	80
5	Richmond	2	220	1200	85
3	Wghse.	2	220	1700	65

250-VOLT D. C. UNITS

Kw.	Generator	Engine	Price
500	C. W.	Tandem	$6500
350	G. E.	Rice & Sar	6500
130	W. E.	Buckeye	2750
2—150	G. E.	Ball	3000
150	Wghse.	Wghse. gas	6000
100	G. E.	Ridgway	3000
100	Ridgway	Ridgway	3000
75	Ridgway	Ridgway	2000
75	G. E.	Harrisburg	2000
75	G. E., 3-wire	Skinner	2500
62½	G. E., 3-wire	Skinner	2000
62½	G. E.	Ames	1650
50	Allis-Chalmers	Chand. Tay.	1250
50	C. W.	Frost	1000
40	Ridgway	Ridgway	1100
35	Northern	Ide	1200
30	Sprague	Harrisburg	1000
30	W. E.	Union I. W.	650
25	G. E.	Ames	850

125-VOLT D. C. UNITS

Kw.	Generator	Engine	Price
150	Wghse.	Ball Wood	$5500
100	Ridgway	Ridgway	$2000
75	G. E.	Harrisburg	1750
75	Ridgway	Ridgway	1750
75	G. E.	Bruce McB. gas	2500
65	Garwood	Harrisburg	1200
50	C. W.	Ames	1000
35	G. E.	G. E. Marine	1500
20	Northern	Ideal	750
15	Cr.	A. & S.	450
15	Sprague	Ames	550

250-VOLT BELTED GENERATORS AND MOTORS

Hp.	Make	Speed	Price
300	G. E.	425	$2200
200	G. E.	210	1500
200	James Clark	395	1250
100	Roth	850	750
65	G. E. type C. L. B.	575	575
60	National	875	450
50	Wghse.	825	500
50	Lincoln	775	450
40	Milwaukee	650	350
30	G. E.	1050	325
30	Wghse.	975	325
25	Lincoln	1250	275
25	G. E. Series	800	225
22	Burke	1100	225
15	Wghse.	1150	225
15	Northern	1300	200
13½	Allis-Chalmers	1175	200
10	Wghse.	750	200
10	G. E.	650	225
10	Akron	1000	175
8½	W. E.	1100	140
7½	G. E.	800	150
7½	G. E. series	900	175

125-VOLT BELTED GENERATORS AND MOTORS

Hp.	Make	Speed	Price
100	Northern	600	$750
60	Northern	725	475
50	Triumph	825	350
45	Sprague	750	325
40	Phoenix	625	300
30	G. E.	1025	275
30	Electron	900	225
25	Triumph	1125	200
22½	Bullock	975	250
20	Onondaga	1100	150
20	Three Rivers	725	200
15	Lincoln	875	175
12½	Fairbanks-M.	825	175
10	Diehl	1300	150
8	W. E.	1225	140
8	Wghse.	1525	140
8	C. W.	1375	140
7½	Al. Chal.	1350	125
5	Browning	1380	120
2	Northern	600/800	75
2	Wghse.	1800	50
2	G. E.	500/1500	75
1	R. & M.	1750	40

BOILERS

HP.	Make	Pressure
2-500	B. & W.	200
2-500	Heine	175
4-400	B. & W.	180
4-267	B. & W.	200
6-250	Heine	160

STANDARD ELECTRIC & ELEV. CO. INC. BALTIMORE

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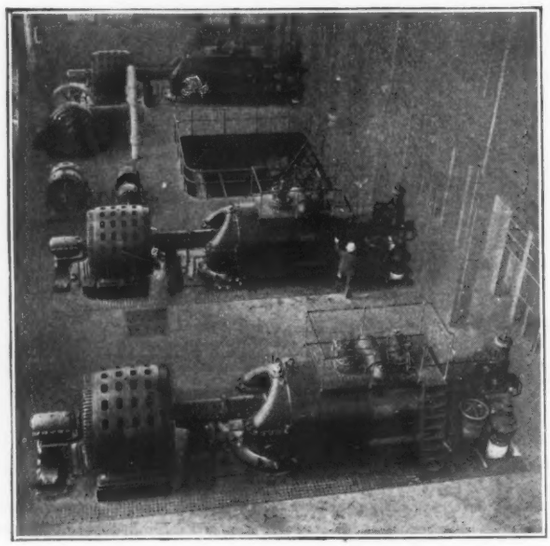

A.C. Turbine Generator Sets

3—2000-kva., 3-phase, 60-cycle, 6600/4000-volt, 1200-r.p.m. Westinghouse-Parsons Horizontal Turbines and Generators, complete with switchboards, exciters and Alberger 8000-sq. ft. surface condenser, with auxiliary pumps. Stirling Boilers are also available. Complete plant equipment can be shipped immediately.

Motor Generator Sets

2—500-kw. Synchronous Motor-Generator Sets, each consisting of:

1—700-kva., Type ATI, G. E. Syn. Motor, 3-phase, 60-cycle, 2300-volt, mounted on a common base and direct connected to

2—250-kw., 3-wire, D.C. Generators, 125-volt each generator, or 250-volt with series connection.

4—**Complete Engine Generator Sets,** each unit consisting of a

60-kw., 120-volt, direct current Ft. Wayne Wood System Generator, direct connected to a Chandler & Taylor horizontal 13 x 13 slide valve steam engine, operating at 240 r.p.m. on 100 lb. steam pressure.

Included with the above sets are:

4—Generator Panels, with the usual meter equipment and circuit breakers and switches on them. All four units are in first class condition and are available for immediate delivery. These outfits are subject to inspection.

DRILLS

3—Type H D.C. 110 v. Cincinnati Electrical Tool Co., portable heavy duty DRILLS, capacity in steel 1¼ in., taper socket No. 4 speed 120 R.P.M.

MOTORS

3-Ph., 60-Cy., 220-Volt and 440-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	1	G. E.	K.	600/1800	U. Stock
1	2	Howell	S.C.	1800	New Stock
1	3	Howell	S.C.	1800	New Stock
1	3	Triumph	S.C.	1800	Used Stock
1	5	A.C.	AN.	1200	New Stock
2	7½	Howell	S.C.	1200	Used Stock
3	7½	Wh.	C.S.	1800	New Stock
1	7½	Wh.	H.F.	1200	Used Stock
1	15	Wag.	Elev.	1200	Used Stock
1	20	Wh.	C.W.	1200	New Stock
4	20	A.C.	ANY	1200	New Stock
7	20	F.-M.	KBV.	1200	New Stock
1	20	G.E.	M.	600	Used Stock
1	25	Wh.	C.S.	1200	New Stock
2	50	A.C.	AN.	720	New Stock
2	75	A.C.	AN.	900	New Stock
1	75	Wh.	C.-W.	900	New Stock
1	100	Wh.	C.S.	900	New Stock
1	100	Wh.	C.W.	720	New Stock
4	150	Wh.	C.W.	720	New Stock
2	150	Wh.	C.W.	600	New Stock
1	150	Wh.	C.W.	900	New Stock
5	200	Wh.	C.W.	720	New Stock
4	200	Wh.	C.W.	600	New Stock

Our stock includes a large number of Auto-Starters and Resistance Starter, for squirrel cage Motors. Also Drum Type and Face Plate Type for Slip Ring Motors.

3-Ph., 60-Cy., 550-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
6	15	Wh.	C.S.	1800	New Stock
1	75	G. E.	M.	514	Used Stock
1	75	Wh.	C.W.	900	New Stock
1	150	Wh.	H.F.	600	Used Stock
1	150	W. E.	M.	600	New Stock
3	150	Wh.	C.W.	600	New Stock
2	200	Wh.	C.W.	600	New Stock
1	200	W. E. M.	3 Brg.	600	New Stock

3-Ph., 60-Cy., 2200-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	75	A. C.	ANY	720	New Stock
2	75	Wh.	C.W.	900	New Stock
1	75	G. E.	M.	514	Used Stock
1	100	Wh.	C.W.	900	New Stock
1	150	Wh.	H.F.	600	Used Stock
1	150	W. E.	M.	600	New Stock
2	150	Wh.	C.W.	600	New Stock
3	150	Wh.	C.W.	720	New Stock
1	200	W. E. M.	3 Brg.	600	New Stock
2	200	Wh.	C.W.	600	New Stock

3-Ph., 25-Cy., 550-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	30	A.C.	A.N.	750	Used Stock

3-Ph., 25-Cy., 220- and 440-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail
1	1	Westg.	CSA	750	New Stock
1	2	Wh.	C.S.	1500	Used Stock
3	2	A.-C.	A.N.	750	New Stock
1	3½	Burke	C.S.	1500	Used Stock
1	5	W. E.	K.	750	New Stock
3	5	A.-C.	A.N.	750	New Stock
1	7½	A.-C.	A.N.	750	New Stock
1	7½	G. E.	M	750	Used Stock
4	10	A.-C.	A.N.	750	New Stock
1	15	W. E.	K.	750	New Stock
1	15	A.C.	AN	1500	Used Stock
2	20	W. E.	K.	750	New Stock
3	30	W. E.	K.	750	New Stock
3	30	A.-C.	A.N.	750	New Stock
4	40	W. E.	K.T.	750	New Stock
3	40	A.-C.	A.N.	750	New Stock
5	50	W. E.	K.	750	New Stock
4	50	A.-C.	A.N.	750	New Stock
2	75	Wh.	C.S.	750	New Stock
1	75	W.E.	K.	1500	New Stock
1	100	W.E.	K.	1500	New Stock
1	150	A.-C.	ANY	500	New Stock
1	150	W. E.	K.	750	New Stock
2	150	W. E.	M.	750	New Stock
2	150	W. E.	M.	500	New Stock

1—200-hp., 3-phase, 25-cycle, 440-volt, 500-r.p.m., used Westinghouse, Type "C" sq. Cage Motor, complete with pulley, rails and starter.

2-Ph., 60-Cy., 220-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	2	G.E.	K.Q.	1200	Used Stock
1	10	W.	H.F.	1200	Used Stock

Single-Phase, 60-Cy. Motors

No.	Hp.	Make	Type	Volts	R.P.M.	Avail.
1	¼	W.H.	A.R.	110-220	1800	N 7-15
1	½	W.H.	A.R.	110-220	1200	N S-W
1	1	W.H.	A.R.	110-220	1800	N 5-30
1	2	Wag.	B.A.	110-220	1200	U Stk.
1	2	W.H.	A.R.	110-220	1800	N 7-15
1	2	W.H.	A.R.	110-220	1200	N 5-15
1	3	W.H.	A.R.	110 220	1200	N 7-15
1	5	W.H.	A.R.	110-220	1800	N 7 30
1	5	W.H.	A.R.	110-220	1200	N 6-15
1	5	Wag.	B.A.	110-220	900	U Stk.
1	5	Wag	Elev.	220	900	U Stk.
1	7½	Wag.	B.A.	110-220	1200	U S-R

110-Volt D.C. Motors

No.	Hp.	Make	Type	Fld.	R.p.m	Avail.
2	2 1/16	R & M		Sh	900	U Stk
1	1	Wh.	R	Sh.	1800	U Stk
1	1½	Diehl	G	Sh	1180	U Stk
1	15	R. & M.		Cpd.	1050	U Stk
1	40	Wh.	M	Sh.	950	U Stk
1	60	Wh.	S.A.	Sh.	1000	U Stk

220-Volt, D.C. Motors

H.P.	Make	Type	Fld.	rpm.	Avail
1	W.H.		Sh	1140	U St.
1 2	New Eng. E.		Sh.	800	U St.
1 3	Triumph		Sh.	1000	U St.
1 3	W.H.	S.	Sh.	1800	U St.
1 3	W.H.	S.	Sh.	2000	U St
1	7½ G.E. Var. Spd.		Cpd.	450/900	U St.
1	7½ C.F.	C.A.	Sh.	1525	U St.
1 10	W.H.	N	Sh.	1250	U St.
1 20	Ft. Wayne B-1		El. Cpd.	820	U St.
1 25	G E.	C.L.	Sh.	675	U St.

Belted D.C. Generators

No.	Kw.	Make	Type	Vlt.	Rpm.	Avail.
1	1.8	F.-M.	T.R.	110	2350	U Stock
1	10	Wh. S.	Cpd.	250	1325	U Stock

Chain Drives

Link Belt Silent Chain Drive

1—Flanged Steel Pinion, 4.987-in. diam., 25 teeth, ½-in. pitch, 1 7/16-in. bore, ½ x ½-in. K. S. tapered to ½-in.

1—Flanged C. I. Wheel, 11.942-in. diam., 60 tee th, ½-in. pitch, 1 7/16-in. bore, ½ x ½-in K. S., tapered to ½ in., CL to CL of drive, 16 in.

This Chain Drive is complete and has never been used. It is in our stock due to change in the plans of the job for which it was ordered.

D.C. Turbine Generator Sets, 125-Volts

Pinion and Gear

1—Spur Gear 1½ D.P., 2.0944-in. C.P., 6-in. face, 56 teeth, 37-33. in. P.D., 4/-in. bore, 1½-in. x ½-in. keyway, complete with Shaft and Bearing for bolting to pedestal foundation.

1—Pinion 1½ D.P., 2. 944-in. C.P., 6-in. face, 23 teeth, 15.33-in. P.D., 4½-in. bore, 1½-in. x ½-in. keyway. Gear ratio 2.4 to 1. 125 hp. at 514 r.p.m.

TRANSFORMERS

Let us know your requirements as we have a large stock available.

FREQUENCY CHANGER SET

25-60 Cycles 4000 Kva. capacity complete and available for early delivery.

Meeting the Emergency Is Standard Practice

TIFFANY HALL & CO., Inc.

ELECTRICAL EQUIPMENT - ENGINEERS
ALSO SPECIALISTS IN HEAVY AND DIFFICULT REPAIRS

In Stock

MOTOR GENERATOR SETS

1722B—One 85-kw., 120-volt, 690-r.p.m., Westinghouse, compound wound D.C. Generator, coupled by flexible coupling to 130-hp., 440/220-volt, 3-phase 60-cycle Westinghouse squirrel cage motor, complete with field rheostat and starting compensator.....**Immediate**

1870—One 75-kw., 125-volt, 680-r.p.m., Westinghouse, type S, compound wound, D.C. Generator, mounted on sub-base with and direct coupled to 110-hp, 440-volt, 3-phase, 60-cycle Westinghouse, type CCL, squirrel cage motor, complete with field rheostat and starting compensator.....**Immediate**

1859B—One 25-kw., 125-volt, 1150-r.p.m., General Electric compound wound, D.C. Generator, coupled by flexible coupling to 40-hp., 440/220-vlot 3-phase, 60-cycle, new General Electric squirrel cage motor, complete with field rheostat and starting compensator.....**Immediate**

A.C. DIRECT CONNECTED UNIT

1712—One 300-kw., 220/440-volt, 150-r.p.m., 3-phase, 60-cycle Westinghouse revolving field alternator, direct connected to 18 and 30 x 24 Erie City cross compound 4-valve automatic engine, complete with belted exciter and switchboard panel.....**Immediate**

D.C. DIRECT CONNECTED UNITS

1873—One 75-kw., 125-volt, 275-r.p.m., Eddy direct current, compound wound Generator, direct connected to 14 x 14 Payne simple center crank Engine, complete.....**Immediate**

1874—One 60-kw., 125-volt, 280-r.p.m., General Electric, direct current, compound wound Generator, direct connected to 13 x 12 Payne simple center crank Engine, complete.....**Immediate**

MOTORS—Immediate Shipment F. O. B. New York or Hoboken

Stock No.	Hp.	Volts	Speed	Phase	Cycles	Make and Type
1936A	250	230	425	DC	DC	Gen. Elec., DMC Interpole
1842	150	440	600	3	60	Crocker-Wheeler Slip Ring
1736	150	440/220	600	3	60	Gen. Elec. Sq. Cage, New
1912	115	500	975	DC	DC	Gen. Elec., DLC Interpole
1572A	100	220/440	1200	3	60	Crocker-Wheeler, Sq. Cage
1738	100	440/220	720	3	60	Gen. Elec., Sq. Cage, New
1556	100	220/440	600	3	60	Westinghouse, Sq. Cage
1913	100	230	850	DC	DC	Gen. Elec., DLC Interpole
1953	75	440/220	1200	3	60	Westinghouse, slip ring, nw
1618	75	220/440	1200	3	60	Gen. Elec., Sq. Cage, New
1573	75	440/220	900	3	60	Crocker-Wheeler, Sq. Cage
1513	75	440/220	900	3	60	Gen. Elec., Sq. Cage, New
1515	75	440/220	720	3	60	Gen. Elec., Sq. Cage
1916	65	230	500	DC	DC	Gen. Elec., DLC Interpole
1915	65	500	600-900	DC	DC	Gen. Elec., RLC Interpole
1917	65	500	725	DC	DC	Gen. Elec., MP
1918	60	230	650	DC	DC	Gen. Elec., MP
1848	50	440/220	900	3	60	Gen. Elec., Sq. Cage
1402	50	440/220	720	3	60	Allis-Chal., Sq. Cage, New
1403	50	440/220	720	3	60	Allis-Chal., Sq. Cage
1404	50	440/220	720	3	60	Allis-Chal., Sq. Cage
1572B	50	220/440	600	3	40	Crocker-Wheeler, Sq. Cage
1861	50	125	700	DC	DC	Crocker-Wheeler
1897	50	550	900	3	60	Gen. Elec., Form L
1898	50	220/440	900	2	60	Gen. Elec., Form L
1919	40	230	400-800	DC	DC	Gen. Elec., RLC Interpole
1920	40	500	600-1200	DC	DC	Westinghouse SK
1837	35	220/440	900	3	60	Gen.Elec., Form L
1924	35	230	400-800	DC	DC	Gen. Elec., RLC Interpole

Stock No.	Hp.	Volts	Speed	Phase	Cycles	Make and Type
1923	35	230	660	DC	DC	Crocker-Wh. Comp. Wound
1921	30	500	625	DC	DC	Allis-Chalmers
1934	30	550	600	DC	DC	Crocker-Wh., Comp. Wd.
1922	30	230	550	DC	DC	Allis-Chalmers
1859A	30	115	900	DC	DC	General Electric
1862	25	115	2200	DO	DC	Gen. Elec. CVC
1758A	25	220/400	1800		60	Gen. Elec. Sq. Cage
1926	20	230	800	DC	DC	Gen. Elec. DLC Interpole
1927	20	500	1100	DC	DC	Westinghouse SK
1850A	20	115	950	DC	DC	Westinghouse SK
1716	20	220	900	3	60	General Electric, Form L
1755	20	220/440	1200	3	40	General Electric, Sq. Cage
1756	20	220/440	1200	3	40	General Electric, Sq. Cage
1757	20	220/440	1200	3	40	General Electric, Sq. Cage
1838	20	220/440	1200	3	60	General Electric, Form L
1761	15	220/440	1200	3	40	General Electric, Sq. Cage
1762	15	220/440	1200	3	40	General Electric, Sq. Cage
1840	15	220/440	1200	3	60	General Electric, Form L
1928	15	230	1000	DC	DC	General Electric, RC
1850A	13	230	875	DC	DC	Westinghouse, S
1427	10	440/220	1800	3	60	Allis-Chal., Sq. Cage, New
1862A	10	115	1100	DC	DC	General Electric CVC
1492	10	230	1000	DC	DC	Fort Wayne
1949	7½	230	1050	DC	DC	Sprague
1658	7½	220/440	1800	3	60	Crocker-Wh., Sq. Cage
729	7½	220/440	1800	2	60	General Electric, Sq. Cage
1933	7½	230	1480	DC	DC	Crocker-Wh., Comp. Wd.
1938	7½	220	1200	3	60	General Elec., Sq. Cage
1661	5	220	1200	2	60	General Electric, Sq. Cage
1683	5	220	1800	3	60	General Electric KT
1954	5	440/220	1500	3	25	General Electric, KT

BELTED D.C. GENERATORS

1936—One 225-kw., 250-volt, 490-r.p.m. General Electric, type DMC, Interpole, compound wound Generator, complete with base, pulley and rheostat

1884—One 200-kw., 125-volt, 600-r.p.m., Crocker-Wheeler, type D, compound wound Generator, complete with rheostat, pulley and base

1722—One 85-kw., 125-volt, 750-r.p.m., direct current, compound wound Westinghouse Generator, complete with pulley base and field rheostat

1856—One 85-kw., 125-volt, 750-r.p.m., direct current, compound wound General Electric Generator, complete with pulley, base and field rheostat

1773—One 75-kw., 125-volt, 700-r.p.m., direct current, compound wound Crocker-Wheeler Generator, complete with pulley, base and rheostat.

1918A—One 50-kw.—250-volt, 800-r.p.m., General Electric, type MP, compound wound Generator, complete with base, pulley and rheostat

1861B—One 45 kw., 125 volt, 800 r.p.m. direct current, compound wound Crocker-Wheeler interpole type Generator complete with pulley base and field

1859—One 25-kw., 125-volt, 1050-r.p.m., direct current General Electric, compound wound Generator, with pulley, base and field rheostat,

1922A—One 25-kw., 250-volt, 700-r.p.m., Allis-Chalmers, compound wound Generator, complete with base, pulley and rheostat

1850—One 10-kw., 250-volt, 1135-r.p.m., direct current, compound wound Westinghouse, type S Generator, complete pulley base and rheostat

BELTED A.C. GENERATORS

1950—One 200-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle General Electric, type ATB Generator, with pulley, base, belted exciter and rheostat.

1951—One 150-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle, General Electric, type ATB Generator with pulley, base, belted exciter and rheostat.

1313—One 100-kw., 2300-volt, 900-r.p.m., 8-pole, 3-phase, 60-cycle, General Electric, type AT Generator, with field rheostat, pulley, slide rail base and exciter

1930—One 60-kw., 2200-volt, 1200-r.p.m., 3-phase, 60-cycle, Bullock-Allis-Chalmers Generator, complete with base, pulley, rheostat, and exciter

1942—One 50-kw., 220/440-volt, 2-phase, 60-cycle General Electric, type AQB, form PB Generator, with pulley, base, rheostat and direct connected exciter

TRANSFORMERS

1891—Three 100-kw., 60-cycle, single phase, 7200/13200-volt primary, 2200/1100 volt secondary General Electric, O.I.S.C., type H Transformers

1892—Three 40-kw., 1100/2200-volt primary, 110/220-volt secondary, single phase, 60-cycle General Electric, O.I.S.C., type H Transformers

OFFICES AND SHOPS

SEVENTH AND ADAMS STS., HOBOKEN, N. J.

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Hoboken 720-721

UNUSUAL OFFERING OF BOILERS

TAKEN OVER FROM DU PONT POWDER CO'S PLANTS

Used from Six Months to Three Years and

PRACTICALLY AS GOOD AS NEW

No. For Sale	Hp.	Make	Type of Construction	Steam Pressure, Lbs.	Location
1	823	Sterling	Butt Strap	200	Carney's Point, N. J
22	600	Edgemoor	Butt Strap	200	Hopewell, Virginia
2	813	Edgemoor	Butt Strap	200	Hopewell, Virginia
4	410	Edgemoor	Butt Strap	175	Barksdale, Wisconsin
4	194	Edgemoor	Butt Strap	175	Barksdale, Wisconsin
28	600	Edgemoor	Lap Joint	175	Hopewell, Virginia
9	512	Sterling	Butt Strap	175	Carney's Point, N. J.
4	505	Sterling	Butt Strap	175	Haskell, N. J.
1	505	Sterling	Butt Strap	175	Parlin, N. J.
8	352	Sterling	Butt Strap	175	Parlin, N. J.
1	253	Sterling	Butt Strap	175	Haskell, N. J.
4	512	Sterling	Lap Joint	160	Carney's Point, N. J.
1	253	Sterling	Lap Joint	160	Haskell, N. J.
2	550	Edgemoor	Lap Joint	150	Carney's Point, N. J.
10	230	Edgemoor	Lap Joint	150	Carney's Point, N. J.
2	252	B. & W.	Lap Joint	150	Carney's Point, N. J.
5	250	Wickes	Butt Strap	150	Hammond, Ind.
1	300	Wickes	Butt Strap	150	Peoria, Ill.
1	250	B. & W.	Lap Joint	125	Columbus, Ohio
2	210	B. & W.	Lap Joint	125	Columbus, Ohio
1	400	Sterling	Lap Joint	150	Vincennes, Ind.
1	260	Sterling	Lap Joint	150	Mt. Union, Penna.
2	150	Sterling	Lap Joint	150	Bronson, Mich.
1	225	Geary	Butt Joint	140	Hartford City, Ind.
1	250	Sterling	Lap Joint	150	Chicago, Ill.
2	300	Heine	Butt Joint	160	Chicago, Ill.
			TUBULAR BOILERS		
2	80	Erie City	60-in. x 16-ft.	125	Chicago, Ill.
5	125	Erie City	72-in. x 16-ft.	125	Carney's Point, N. J.
4	200	H. S. & G.	78-in. x 20-ft.	125	Kentucky
2	250	H. S. & G.	84-in. x 20-ft.		
4	100	Schofield	66-in. x 16-ft.	145	Ferguson, S. C.

Also New Keeler Boilers and other makes and sizes—every one tested.

I am in a position to make contracts, at very attractive figures, to install these boilers, ready for service. Every boiler guaranteed. Write or wire for prices.

J. F. DAVIS

1122-1123-1124 HARRIS TRUST BLDG., CHICAGO, ILL.

BARGAINS!—STOCK SHIPMENT

Alternating Current Motors
All New, 3-Phase, 60-Cycle

No.	Hp.	R.p.m.	Volts	Type	Make
7	3	1800	220 or 440	AN	Allis Chal.
1	3	1200	220 or 440	AN	Allis-Chal.
11	5	1800	220 or 440	AN	Allis Chal.
10	5	1200	220 or 440	AN	Allis-Chal.
4	7½	1800	220 or 440	AN	Allis-Chal.
3	7½	1200	220 or 440	AN	Allis-Chal.
3	7½	900	220 or 440	AN	Allis-Chal.
11	10	1800	220 or 440	AN	Allis-Chal.
13	10	1200	220 or 440	AN	Allis Chal.
3	10	900	220 or 440	AN	Allis-Chal.
1	15	1800	220 or 440	AN	Allis-Chal.
4	15	1200	220 or 440	AN	Allis-Chal.
6	15	900	220 or 440	AN	Allis-Chal.
1	20	1800	220 or 440	AN	Allis-Chal.
4	20	1200	220 or 440	AN	Allis-Chal.
3	20	900	220 or 440	AN	Allis-Chal.
1	25	1800	220 or 440	AN	Allis Chal.
3	25	1200	220 or 440	AN	Allis-Chal.
1	25	900	220 or 440	AN	Allis-Chal.
9	30	1200	220 or 440	AN	Allis-Chal.
6	30	900	220 or 440	AN	Allis-Chal.
3	40	1200	220 or 440	AN	Allis-Chal.
2	50	1200	220 or 440	AN	Allis Chal.
5	40	900	220 or 440	AN	Allis-Chal.
6	50	900	220 or 440	AN	Allis Chal.
1	75	1750	220 or 440	CS	Westghse.
1	75	1200	220 or 440	AN	Allis-Chal.
1	75	900	220 or 440	CS	Westghse.
1	75	900	220 or 440	AN	Allis Chal.
2	75	720	220 or 440	AN	Allis-Chal.
6	100	900	220 or 440	AN	Allis-Chal.
1	100	720	2200	AN	Allis-Chal.
3	100	720	220 or 440	AN	Allis-Chal.
1	100	900	2200	AN	Allis Chal.
1	150	900	2200	AN	Allis-Chal.
3	150	900	220 or 440	AN	Allis-Chal.
1	150	720	2200	AN	Allis-Chal.
2	150	720	220 or 440	AN	Allis-Chal.
1	200	720	220 or 440	AN	Allis-Chal

Alternating Current Motors
Slip Ring, 3-Phase, 60-Cycle

No	Hp.	R.p.m.	Volts	Type	Make
3	30	900	220 or 440	ANY	Allis Chal.
2	50	900	220 or 440	ANY	Allis-Chal.
4	75	900	220 or 440	ANY	Allis-Chal.
2	75	720	220 or 440	ANY	Allis-Chal.
3	100	900	220 or 440	ANY	Allis Chal.
2	100	720	220 or 440	ANY	Allis-Chal.
2	150	900	220 or 440	ANY	Allis-Chal.
3	150	720	220 or 440	ANY	Allis-Chal.
1	150	900	2200	ANY	Allis-Chal.
1	150	720	2200	ANY	Allis Chal.
3	200	720	2200	ANY	Allis-Chal.

All of the above Slip Ring Motors, complete with drum controllers

Direct Current Motors
All Rebuilt, 230 to 250 Volts

No	Hp.	R.p.m.	Wdg.	Type	Make
1	¼	975	Sh.	....	Westghse.
1	1	750	Series	D	Mech. App.
1	1	1100	Sh	CA	G. E.
1	2	1000	Sh	MP	Fidelity
4	2½	700/900	Sh	S	Westghse.
2	3	1100	Sh	MP	Fidelity
2	3	580/1160	sh	SA	Westghse.
2	5	1100	Sh	MP	Fidelity
1	5	1750	Sh	MP	Fidelity
1	5	1100	Sh	SK	Westghse.
1	6	750/1500	Sh	SK	Westghse.
10	7½	500/1500	Sh.	SK	Westghse.
1	7½	850	Sh	SK	Westghse.
		With controllers used 3 months			
5	8½	900/1800	Sh.	SK	Westghse.
1	10	1150	Sh	SK	Westghse.
1	10	850	Sh	SK	Westghse.
2	10	900	Sh	MP	Fidelity
3	11½	500/1500	Sh.	SK	Westghse.
1	13	875	Sh	S	Westghse.
1	15	690	Sh	CE	G. E.
1	15	500/1500	Sh	SA	Westghse.
1	15	750	Sh.	MP	Milwaukee
1	17½	585	Sh.	A-14	Gibbs
1	20	900	Sh.	MP	Hobart
1	20	650	Sh.	MP	Milwaukee
1	20	600	Sh.	MP	W. E.
1	20	800	Sh.	MT	Imperial
1	40	575	CP	MP	Milwaukee
1	50	525	Sh.	MP	Northern
1	50	625	Sh.	A-40	Milwaukee
1	55	575	Cp.	MP	Western Elec
1	75	850	Cp.	MP	Milwaukee
2	135	750	Cp.	SK	Westghse.

Direct Current Engine Generator Sets
All Rebuilt, 230 to 250 Volts

1—15-kw., 230-volt, 750-r.p.m., sh. wd. Milwaukee Generator, belted to 1—28-hp., 250-r.p.m. Champion Gas engine complete.

1—20-kw., 230-volt, 700-r.p.m., sh. wd. Northern Electric Generator, belted to 1—28-hp. Struthers-Wells gas engine.

1—37½-kw., 650-r.p.m., sh.wd. Northern Generator complete, belted to 1—Ball steam engine, complete with all accessories.

1—37½Kw., 700-r.p.m. sh.wd. Milwaukee generator complete belted to Ball steam engine complete with all accessories.

1—100-kw., 250-volt, 650-r.p.m., cp.wd., Type M Westinghouse Generator, belted to Lord Howler 220-r.p.m. steam engine complete.

1—100-kw., 860-r.p.m., 240-volt, D.C., Type SK Westinghouse Generator (used 3 months), belted to Lord Howler steam engine, complete.

1—100-kw., 860-r.p.m., 240-volt, D.C., Type SK Westinghouse Generator (used 3 months), belted to 3-cylinder, 125-hp. Westinghouse vertical gas engine, complete.

Locomotive

1—7-ton 250 VDC. Morgan-Gardner 42-in gage Haulage Locomotive

"AMERICA'S BARGAIN HOUSE"

Office and Factory PITTSBURGH, PA.

DUQUESNE ELECTRIC & MANUFACTURING COMPANY

NEW AND REBUILT ELECTRICAL EQUIPMENT

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Cable Address —"DEMCO"

Reliable—POWER PLANT MACHINERY

MOTORS—ALTERNATING CURRENT
3-Phase, 60-Cycle, Slip Ring Type

No.	Hp.		Make	Volt	R.p.m.	Form
1	10	New	Gen. Elec.	440	1200	M
1	15	New	Gen. Elec.	440	1200	M
1	25	New	Gen. Elec.	440	1200	M
1	30	New	Gen. Elec.	440	990	M
1	40	New	Gen. Elec.	440	1200	M
1	40	New	Oen. Elec.	440	900	M
1	50	New	Gen. Elec.	440	900	M
1	50	New	Allis-Chal.	440	900	ANY
1	75	New	Gen. Elec.	440	900	M
2	100	New	Gen. Elec.	440	900	M
2	150	New	Gen. Elec.	440	600	M
1	200	Used	Allis-Chal.	440	600	ANY

MOTORS—ALTERNATING CURRENT
3-Phase, 60-Cycle Squirrel Cage

No.	Hp.		Make	Volt	R.p.m.	Type
3	2	New	Gen. Elec.	220	1800	K.T.
6	3	New	Gen. Elec.	220	1800	K.T.
4	3	New	Gen. Elec.	220	1200	K.T.
24	5	New	Gen. Elec.	220	1800	K.T.
10	5	New	Gen. Elec.	220	1200	K.T.
8	7½	New	Gen. Elec.	220	1800	K.T.
6	7½	New	Gen. Elec.	220	900	K.T.
5	10	New	Gen. Elec.	220	1200	K.T.
8	15	New	Gen. Elec.	220	1200	K.T.
1	20	New	Gen. Elec.	220	1200	K.T.
5	20	New	Gen. Elec.	220	1200	K.T.
4	20	New	Gen. Elec.	220	900	K.T.
5	25	New	Gen. Elec.	220	1200	K.T.
4	25	New	Gen. Elec.	220	900	K.T.
3	25	New	A.-C.	220	580	....
4	30	New	Gen. Elec.	220	1200	K.T.
4	30	New	Gen. Elec.	220	900	K.T.
5	40	New	Gen. Elec.	220	1200	K.T.
2	40	New	Gen. Elec.	220	900	K.T.
3	50	New	Gen. Elec.	220	900	K.T.
3	75	New	Gen. Elec.	220	900	K.T.
2	100	New	Gen. Elec.	220	900	K.T.
1	150	Used	Westghse.	2200	720	C.C.L.

(Any of the above 220-volt Motors can be furnished suitable for 440 volts)

STEAM ENGINES

1—300-hp., 20 x 42 Hamilton Corliss.
1—250-hp., 18 x 36 Hamilton Corliss.
1—125-hp., 14 x 28 Filer & Stowell.
1—150-hp., 15 x 14, Ideal Automatic.
1— 90-hp., 14 x 18 Houston, Stanwood & Gamble
1— 50-hp., 12 x 16 Industrial
1— 50-hp., 11 x 14 Brownell.
1— 35-hp., 10 x 15 Erie.
1— 30-hp., 10 x 12 Chandler & Taylor.
1— 25-hp., 8 x 12 Houston, Stanwood & Gamble
1— 12-hp., 7 x 10 Atlas.
1— 4-hp., 4 x 5 Clark Vertical.

BOILERS

2—502-hp. Sterling, 200-lb. pressure.
2—400-hp. Sterling, 160-lb. pressure
1—330-hp. Heine, 180-lb. pressure.
2—250-hp. Sterling, 150-lb. pressure.
8—150-hp., 72 x 18, high pressure, return tubular.
1—125-hp., 72 x 16, high pressure, return tubular.
1—100-hp., 66 x 16, return tubular.
1— 80-hp., 60 x 16, high pressure, return tubular.
1— 70-hp., 54 x 16, return tubular.
1— 60-hp. Firebox or Locomotive Type, on skids.
1— 60-hp., 54 x 14, high pressure, return tubular.
1— 35-hp., Firebox or Locomotive Type, on skids
1— 25-hp., 42 x 7½ ft. vertical.
1— 20-hp., 36 x 90, vertical.
1— 10-hp., 30 x 7½ ft., vertical.

ALTERNATING CURRENT GENERATORS
Belted and Direct Connected

3—1250-kw. Westingnouse-Parsons, 3-phase, 60-cycle, 11,000-2300-volt Turbo Generator Sets (without condensers).
1—360-kw., 3-phase, 60-cycle, 480-volt General Electric Generator, direct connected to a 24 x 25 Fleming-Harrisburg Corliss Engine.
1—250-kw. Westinghouse, 3-phase, 60-cycle, 2300-volt, 450-r.p.m., belted Alternator.
2—125-kva. Kerr-Burke, 3-phase, 60-cycle, 480-vo.t, 3600-r.p.m. Turbo Generator Sets, with jet condensers.
1—100-kw. General Electric, 3-phase, 60-cycle, 2300-volt Turbo Generator Set with condenser.
1—90-kva. Electric Machinery Company, 3-phase, 60-cycle 2200-volt, 1200-r.p.m., revolving field Alternator.
1—85-kw. Allis-Chalmers, single phase, 60-cycle, 2200-volt, 900-r.p.m., revolving field Alternator.
1—75-kw. Westinghouse, 3-phase, 60-cycle, 440-volt, 720-r.p.m., belted Alternator.
2—75-kva. Burke, 3-phase, 60-cycle, 2300-volt, Alternator, with direct connected exciters, each direct connected to a 13 x 15 Skinner automatic, self-oiling Engine, with high-grade switchboard and instruments for controlling.

DIRECT CURRENT MOTORS

No.	Hp.	Make	Volt	R.p.m.
1	50	Rebuilt Fairbanks-M.	250	900
1	50	Rebuilt Allis-Chalmers	250	1050
1	30	Rebuilt Northern	220	600
1	25	Rebuilt Fisher	250	500
2	20	New General Electric	230	1150
2	15	New General Electric	230	1150
4	10	New General Electric	230	1150
1	7½	Interpole	220	550-1100
5	5	New General Electric	220	1150

DIRECT CURRENT GENERATORS
Belted and Direct Connected

1—5-kw. Allis-Chalmers, 125-volt, 1350-r.p.m. compound wound Generators.
1—10-kw. Commercial, 120-volt, 1000-r.p.m., compound wound Generator.
1—25-kw. Triumph, 120-volt, 1000-r.p.m., compound wound Generator.
1—40-kw. Fairbanks-Morse, 220-volt, 900-r.p.m., compound wound Generator.
1—35-kw., 250-volt, 300-r.p.m. Crocker-Wheeler Generator, direct connected to a 10 x 10 Ames Automatic Engine.
1—50-kw. General Electric, 125-volt, compound wound Generator direct connected to an 11 x 14 Buckeye Automatic Engine.
1—75-kw. Ft. Wayne, 250-volt, compound wound Generator, direct connected to a 13 x 16 Russell Automatic Engine.
1—150-kw. Crocker-Wheeler, 275-volt, compound wound Generator, direct connected to a 16 x 16 Phoenix Automatic Engine.
2—175-kw. Thompson-Ryan, 250-volt, compound wound Generator, each direct connected to a 19 x 20 McEwen Automatic Engine.

MOTOR GENERATOR SETS

1—100-kw. General Electric, 250-volt Generator, direct connected to a 3-phase, 60-cycle, 2300-volt Synchronous Motor, with switchboard and instruments for controlling.
1—100-kw. Westinghouse Set, as above.
1—New 150-kw. General Electric, 275-volt 1200-r.p.m., compound wound, direct current Generator, mounted on same base with and direct connected to a 225-kva., type ATI General Electric, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Motor, with a 2-panel switchboard and instruments for starting and controlling.
1—300-kw. General Electric, 550-volt, 720-r.p.m., direct current Generator, with direct connected exciter mounted on same base with and direct connected to a 430-hp. General Electric, 3-phase 60-cycle, 2300-volt Synchronous Motor.
2—New 500-kw. General Electric, 575-volt, 514-r.p.m., direct current Generators, mounted on same base with and direct connected to a 720-hp., 3-phase, 60-cycle, 6600-13,200-volt Synchronous Motor.

THE RANDLE MACHINERY COMPANY

Established 34 Years

Located ONLY at 1822 POWER STREET, CINCINNATI, OHIO

INDEPENDENT ELECTRIC MACHINERY CO.

CENTRAL STREET and GOODRICH PLACE, KANSAS CITY, MO.

25-CYCLE, 3-PHASE, 220-440 VOLT MOTORS

No.	H.P.	Name	Speed
1	1	Westinghouse	680
1	1	Richmond	1420
1	1	General Electric	1500
1	2	General Electric	1500
2	3	Ideal	1400
3	3	Robbins & Myers (New)	1400
5	3	General Electric	1500
2	5	Ideal	1450
1	5	Robbins & Myers (New)	1400
1	5	Western Electric	1420
1	5	General Electric	750
1	5	Westinghouse	Var.
2	7½	Robbins & Myers (New)	1400
2	7½	General Electric	1500
3	15	General Electric	1500
1	15	Ideal	1430
1	15	Robbins & Myers (New)	720
3	15	Burke	750
1	25	Burke	750
1	40	Westinghouse	710
1	50	General Electric	750

60-CYCLE, 3-PHASE, 220-VOLT MOTORS

No.	H.P.	Name	Speed
1	½	Fairbanks-Morse	1200
1	1	General Electric	Var.
12	1	Robbins-Myers—New	1750
4	1	Robbins-Myers—New	1150
1	1	General Electric	Var
3	2	Robbins & Myers (New)	1750
14	2	Robbins-Myers	1750
5	2	Robbins-Myers	1150
1	5	Northern	1150
22	3	Robbins & Myers (New)	1750
10	3	Robbins & Myers (New)	1150
32	5	Robbins & Myers (New)	1750
10	5	Robbins & Myers (New)	1150
3	5	Crocker-Wheeler (New)	1750
1	5	Wagner (New)	1140
1	5	Robbins-Myers—New—Elevator type	1200
1	5	Fairbanks-Morse	1800
1	7½	Robbins & Myers (New)	1150
1	7½	Allis Chalmers	1150
1	7½	Ideal	1720
9	7½	Robbins & Myers (New)	1750
1	7½	Ideal	1800
2	7½	Robbins & Myers (New)	850
1	10	Wagner (New)	1140
6	10	Robbins & Myers (New)	1150
5	10	Robbins & Myers (New)	1750
2	10	Robbins & Myers (New)	850
5	15	Robbins & Myers (New)	1750
2	15	Robbins & Myers (New)	1150
2	15	Robbins & Myers (New)	850
1	15	General Electric	1740
4	20	Robbins & Myers (New)	1150
2	20	Robbins & Myers (New)	1750
1	20	Robbins & Myers	850
1	20	Westinghouse—sl. rg	800
2	25	Robbins & Myers (New)	1750
1	25	Robbins & Myers (New)	1150
2	25	Robbins & Myers (New)	850
1	25	Lincoln	2200 V.—1200
3	30	Robbins & Myers (New)	1150
1	30	Robbins & Myers (New)	840
1	30	West. El., Slp.rg.	2200 V.—350
2	35	Wagner	1730
1	35	General Electric	2200 V.—1150
1	40	Allis Ch., Sq. Cg.	2200 V.—865
1	40	Allis-Chalmers—New—S.R.	860
1	50	Allis-Chalmers—New—S.R.	690
1	50	Westing., Slp rg.	2200 V.—725
1	50	Allis Ch., Sq. Cg.	2200 V.—865
1	50	Allis Chalmers Slip Ring	865
1	50	Allis Ch., Slp. rg.	2200 V.—865
1	50	Wagner	850
1	75	General Electric—Sl. Rg.	900
1	75	Allis-Ch., Slp. rg. 2200V—	865
2	100	Allis Chalmers (slip ring) 2200V	865
1	100	General Electric—2200 V.	695
1	125	Allis-Chalmers	1800
1	200	Allis-Chalmers	580
1	200	Ideal	600

220 VOLT D.C. MOTORS

No.	Hp.	Name	Speed
2	5	Robbins & Myers	1400
1	5	Reliance	1750
1	7	Holtzer-Cabot	1200
1	5	Robbins-Myers (back geared)	900
3	7½	General Electric	815
2	7½	Northern	1650
5	10	Crocker-Wheeler	825
1	10	Northern	825
1	10	American Engine Co.	1140
1	12½	Robbins & Myers	850
1	15	Electric Mchy. Co.	1050
1	15	General Electric (Crane)	600
1	15	Northern	535
1	20	Crocker-Wheeler	775
3	30	General Electric (Vertical)	1500
1	110	Crocker-Wheeler	560

110-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	35	W. E.	775
1	50	G. E.	1150
1	50	Westinghouse	850
1	50	Eddy	800
1	75	W. E., engine type	275

220-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	12½	Fairbanks-Morse, 3-wire	1450
1	17½	Triumph	1200
1	60	Commercial	700
1	60	Westinghouse	850
1	75	Northern	700
1	80	Thompson-Ryan	600
1	225	Crocker-Wheeler	450

DIRECT CONNECTED SETS

1—30-kw., 220-volt, 300-r.p.m. Akron generator direct connected to 10 x 10 Buffalo Forge Co. engine, complete.

1—50-kw., 125-volt, 280-r.p.m. General Electric generator, direct connected to 11 x 12 G. E. Marine steam engine, complete.

1—75-kw., 220-volt, 275-r.p.m. Crocker-Wheeler generator, direct connected to a 15 x 16 Harrisburg-Fleming steam engine with balancer set.

1—100 kw., 220 volt, 250 r.p.m. Crocker Wheeler generator, direct connected to a 10 x 16 x 14 simple compound horizontal Ball engine.

1—100-kw., 220-volt, 260-r.p.m. General Electric Generator, direct connected to 15 x 21 Ball self-contained automatic engine.

ALTERNATORS

1—50 kva., 2200 volt, 60 cycle, 3 phase, 1200 r.p.m. Westinghouse alternator, complete.

1—62½ kw., 2200 volt, 60 cycle, 3 phase, 300 r.p.m. Bullock alternator, direct connected to an Almes steam engine, all complete.

1—75 kva., 2300 volt, 60 cycle, 1 phase, 900 r.p.m. General Electric alternator complete.

1—80 kva., 2300 volt, 60 cycle, 3 phase, 225 r.p.m. Ft. Wayne alternator, direct connected to 110 hp. Buckeye Producer Gas Engine, complete.

1—85 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Allis Chalmers alternator direct connected to an Erie City steam engine, 12 x 12, all complete.

1—100 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Westinghouse alternator, direct connected to 125 hp Erie engine.

1—150 kva., 2300 volt, 60 cycle, 3 phase 200 r.p.m. General Electric alternator, direct connected to a 14½ x 24 x 18 Mansfield automatic steam engine, complete.

1—150 kva., 2300 volt, 60 cycle, 3 phase, 720 r.p.m. Electric Machinery, alternator, complete with exciter.

"HONESTLY REBUILT" ELECTRICAL MACHINERY

You can purchase our product with the same assurance that you would buy New Electrical Machinery. For all practical purposes it is just as good.

SPECIAL OFFERINGS

3—100-kva. Westinghouse, 1-phase, 60-cycle Transformers, 13,200-12,600-12,000-volt primary 465-445-437-423-volt, sec. rebuilt by Westinghouse. Price $1000 for all.

3—75-kw. General Electric, 1-phase, 60-cycle, Type H-RR Transformers, 2300-2185-2070-volt prim. 370-185-volt, sec. for 200-kw., 600-volt, D.C. rotary. Price for all $900.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 1140-r.p.m. Motor, with starting panel. price $1000.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 900-r.p.m. Motor with starter. Price $1250.

175-hp., 3-phase, 60-cycle, 2300-volt Allis-Chalmers 860-r.p.m., Slip Ring Motor, with Cutler-Hammer, drum controller, resistance and G.E. Oil Circuit Breaker. Price $1350.

6—132-hp., 3-phase, 60-cycle, 2300-volt General Electric, type I, form L Wound Rotor Motors. Price $1200 each.

2—100-hp., 3-phase, 60-cycle, 220-volt Allis-Chalmers, AN 1750-r.p.m. Motors. Price $575 each.

2—75-hp., 3-phase, 60-cycle, 220-volt Westinghouse, CCL, 685-r.p.m. Motors, complete. Price $750 each.

150-kw., 250-volt, D.C. C & C Elec. & Mfg. Co., type MPL, 6-pole compound wound, 500-r.p.m. Generator, complete with switchboard. Price $1250.

125-kw., 250-volt, D.C. Westinghouse, 6-pole, compound wound, 580-r.p.m. Generator, complete with switchboard. Price $1400.

2—75-kw., 250-volt, D.C. Crocker-Wheeler, 200-r.p.m. Generators, direct connected to Alberger Gas Engines. Price $4000.

25-kw., 250-volt, D.C., Crocker-Wheeler Generator, 300-r.p.m., direct connected to Alberger Gas Engine, with switchboard, Price $1000.

35-kw., 125-volt, D.C. General Electric-Curtis Turbo Generator, 3600-r.p.m., 125-lb. ST. Price $1000.

MOTOR GENERATOR SET

250-kw., 125/250-volt, D.C. Allis-Chalmers 2-phase, 25-cycle, 2300-volt Synchronous speed 750.

200-kw., 250-volt, D.C. General Electric, 3-phase, 25-cycle, 2300-volt Synchronous, speed 750.

2—200-kw., 250-volt, D.C. Allis-Chalmers, 3-phase, 25-cycle, 2300-volt, 750-r.p.m. Rotarys, with transformers.

200-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 900-r.p.m. Synchronous Set.

3—150-kw., 250-volt, D.C. General Electric 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 600-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt Rotary, with transformers.

100-kw., 500-volt, D.C. Allis-Chalmers, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

75-kw., 250 volt, D.C. Crocker-Wheeler, 3-phase, 60-cycle, 2300-volt, 720-r.p.m. Induction Set.

75-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 900-r.p.m. Synchronous Set.

50-kw., 250-volt, D.C. General Electric, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Synchronous Set.

25-kw. 220-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Induction Set.

10-kw., 250-volt, D.C. Watson, 3-phase, 60-cycle, 220-volt. 1200-r.p.m. Induction Set.

7½-kw., 220-volt, D.C. Western Electric, 3-phase, 60-cycle, 220-volt, 1800-r.p.m. Induction Set.

7½-kw., 125-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Induction Set.

2—2½-kva., 1-phase, 60-cycle, 110-volt Crocker-Wheeler, 125-volt, D.C., 1800-r.p.m. Motor Generators.

2—2½-kw., 125-volt, D.C. Crocker-Wheeler, 500-volt, D.C., 1800-r.p.m. Motor Generators.

⅛-kw., 125-volt, D.C. General Electric, 1-phase, 60-cycle, 220-volt, 1800-r.p.m. Motor Generator.

25-amp., 8-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m. Induction Set.

25-amp., 28-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m., Induction Set.

10-kw., 60-volt, D.C. Northern, 125-volt, D.C., 835-r.p.m. Booster Set.

3-PHASE, 25-CYCLE MOTORS

Hp.	Make	Type	Speed
3	Westinghouse	CS	1400
15	General Electric	I.M., 2300-volt Slip Ring	750
20	Allis-Chalmers	AN	750
2—35	Allis-Chalmers	ANY 2300-volt Slip Ring	720
35	General Electric	IK	500
35	Westinghouse	CS	720
37	General Electric	"ITC" Slip Ring	685
3—52	General Electric	"ITC" Slip Ring	685

ALTERNATING CURRENT GENERATORS

30-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

30-kva., 3-phase, 25-cycle, 220-volt Westinghouse, speed 750-r.p.m.

50-kva., 2-phase, 60-cycle, 240-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 2300-volt, General Electric, speed 1200-r.p.m.

100-kva., 3-phase, 60-cycle, 220-volt Westinghouse, speed 900-r.p.m.

250-kw., 3-phase, 60-cycle, 220-volt Westinghouse speed 450-r.p.m.

350-kva., 3-phase, 25-cycle, 2300-volt Allis-Chalmers, direct connected to Harrisburg Fleming Steam Engine.

220-250-VOLT, D.C. GENERATORS

Kw.	West		
15	Westinghouse	S	900
25	Crocker-Wheeler	CCM	300
42½	Sprague	SB	725
50	Crocker-Wheeler	Engine	275
75	Westinghouse	S	725
85	Westinghouse	S	725
100	General Electric	Engine	725
100	Triumph	MP	650
125	Westinghouse	MP	580
150	C & C Electric	MP6	500
200	Westinghouse	MP6	500
200	General Electric	Engine	200

SPECIAL NOTICE

Our large and varied stock of A.C. and D.C. Motors will be sold this month at greatly reduced prices.

PITTSBURGH'S ELECTRICAL CLEARING HOUSE

ESTABLISHED 1908

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We cordially invite inspection of our new Warehouse, Salesroom and Shop

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POWER MACHINERY

IN STOCK FOR PROMPT SHIPMENT

TURBO-GENERATOR UNITS—60 Cycle

10,000 Kw. Westinghouse Parsons Horizontal Turbo-Generator Unit, 3 Phase, 60 Cycle, 13800 Volts, 1800 r.p.m. Can be reconnected to any other standard voltage. ABSOLUTELY NEW. Suitable surface condenser and condenser auxiliaries. Send for full details and specifications.
1—1250 Kva. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 2300 volts, r.p.m., with LeBlanc jet type condenser and turbine driven pumps.
1—750 KW. General Electric-Curtis horiz. turbo-unit, 3 phase, 2300 volts, 3600 r.p.m. mixed pressure with C. H. Wheeler surface condenser vacuum and circulating pumps etc.,
2— 625 Kva. Westinghouse-Parsons horiz. turbo-units, 3 phase, 440 volts, 3600 r.p.m.
1—550 KW. Gen. Elec.-Curtis vertical, non-condensing turbo-unit, 3 phase, 4600 or 2300 volts, 1800 r.p.m.
1—500 KW. Allis-Chalmers horizontal turbo-unit, 3 phase, 480 volts, 3600 r.p.m., with Allis-Chalmers jet condenser and necessary pumps.
1—500 Kw. Gen. Elec.-Curtis vertical turbo-unit, 3 phase, 4000-2300 volts, 1800 r.p.m., with Wheeler Cond. & Eng'g Co. jet condenser and necessary pumps.
1—500 Kw. General Electric-Curtis horizontal turbo unit, 3 phase, 2300 volts, 3600 r.p.m., 4 stage, condensing, complete withcondenser, pumps and switchboard equipment.

TURBO-GENERATOR UNIT—25 Cycle

1—6500 Kw. Allis-Chalmers horizontal turbo unit, 3 phase, 6600 volts, 4 pole, 750 r.p.m.

ROTARY CONVERTERS—60 Cycle

3—500 Kw. Westg., 6 phase, 60 cycle, commutating pole, 250 volts D.C., 2000 amps. D.C., 177 volts A.C., 6 pole, 1200 r.p.m. With each rotary are three 183 Kva. Westg. type, SKR, single phase, OI SC transformers, 6900 volts delta high tension. 15% inherent reactance also A.C. and D.C. panels, complete with necessary instruments.
THE ABOVE UNITS ARE ABSOLUTELY NEW.
1—400 Kw. Gen. Elec., type HC, form P, 6 ph., 60 cy., 8 pole, 600 volts D.C., 667 amps. D.C., 430 volts A.C., 900 r.p.m., with switchboard and necessary instruments.
1—150 Kw. Westg., 6 ph., 60 cy., 250 volts D.C., 600 amps. D.C., 177 volts A.C., 6 pole commutating pole, 1200 r.p.m. Transformer: 165 Kva. West., 3 ph., 6900 volts prim., OI SC. 15% inherent reactance; also A.C. and D.C. panels with necessary instruments.
THE ABOVE UNIT IS ABSOLUTELY NEW.

ROTARY CONVERTERS—25 Cycle

1—1500 Kw. General Elec., type HC, form N, 6 ph., 25 cy., 14 pole, 250 volts D.C., 5700 amps. D.C., 214 r.p.m., with electrically operated and controlled field rheostat, automatic overload and speed limit device.
1—300 Kw. National, type RT, 3 ph., 25 cy., 550 volts D.C., 545 amps. D.C., 330 volts A.C., 526 amps. A.C., 6 pole, 500 r.p.m.
1—250 Kw. Elec., type TC, form A, 3 ph., 25 cy., 4 pole, 550 volts D.C., 455 amps. D.C., 350 volts A.C., 750 r.p.m.; also A.C. and D.C. panels complete with instruments.

We shall be glad to mail complete list of Electrical, Steam and Hydraulic Machinery upon request.

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Pittsburgh Office: 498 Union Arcade Building

READY FOR IMMEDIATE DELIVERY

ALTERNATING CURRENT DIRECT CONNECTED SET

1—145 Kva., 3-phase, 60-cycle, 220/440 volt, Westinghouse, revolving field generator, 257 r.p.m., direct connected on one shaft to 18 x 16 Erie Ball engine, complete with switchboard and exciter.

ALTERNATING CURRENT BELTED GENERATORS

1—450 Kw., 3 phase, 60 cycle, 2200 volt, 400 r.p.m., General Electric, type ATB.
1—300 Kva., 3 phase, 60 cycle, 2300 volt, 164 r.p.m., General Electric, type ATB.
1—200 Kw., 3 phase, 60 cycle, 1150 volt, 600 r.p.m., General Electric, type ATB.
1—300 Kw., 3 phase, 40 cycle, 600 volt, 600 r.p.m., General Electric, type ATB.
1—150 Kw., 3 phase, 40 cycle, 550 volt, 300 r.p.m., General Electric, type ATB.
1—75 Kw., 3 phase, 60 cycle, 220 volt, 720 r.p.m., revolving armature Westinghouse generator.

LARGE ALTERNATING CURRENT MOTORS

1—1000 HP., synchronous motor, 2 phase, 60 cycle, 2300 volt, 300 r.p.m., General Electric, type AQB.
1—450 HP., 3 phase, 40 cycle, 550 volt, 400 r.p.m., type LM, General Electric.
1—225 HP., 550 volt, 3 phase, 60 cycle, 514 r.p.m., form L, General Electric motor.
1—175 HP., General Electric, 3 phase, 60 cycle, 550 volt, 600 r.p.m., type M motor.
1—150 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 720 r.p.m., type M motor.
1—100 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 720 r.p.m., type M motor.
1—75 HP., Westinghouse, 3 phase, 60 cycle, 550 volt, 690 r.p.m., type CW new motor.
1—50 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 1200 r.p.m., type MT motor.
1—50 HP., General Electric, 3 phase, 60 cycle, 550 volt, 1200 r.p.m., type KT motor.
2—150 HP., 575 r.p.m., General Electric, 3 phase, 60 cycle, 2200 volt, type M motors.
1—100 HP., Western Electric, 3 phase, 60 cycle, 720 r.p.m., form M motor, 2200 volt.
1—100 HP., Western Electric, 3 phase, 60 cycle, 440 volt, 720 r.p.m., type M.
1—75 HP., Western Electric 3 phase, 60 cycle, 440 volt, 720 r.p.m., type M.
1—50 HP., Western Electric 3 phase, 60 cycle, 440 volt, 1200 r.p.m., type M.
1—150 HP., Westinghouse, 3 phase, 60 cycle, 385 r.p.m., 220 volt, type CW.
1—75 HP., General Electric, 3 phase, 60 cycle, 220 volt, type K, 900 r.p.m.
1—75 HP., General Electric, 3 phase 60 cycle 220 volt, 720 r.p.m., type K.
1—75 HP., General Electric, 3 phase, 60 cycle, 220 volt, 720 r.p.m., type M.

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230 VOLTS D. C. MOTORS

Qu.	H.P.	Speed	Make
*1	130	500	Westg.
1	40	1150	Jantz-Leist
1	30	900	Fairbanks-M.
1	25	850	Peerless
1	20	600	Jantz-Leist
1	20	630	Triumph
1	20	750	Jantz-Leist
1	20	800	Imperial
2	20	955	Peerless
1	20	1150	Peerless
1	20	1200	Jantz-Leist
1	15	1000	Akron
2	15	1020	Peerless
1	15	1200	G. E.
1	15	1300	G. E.
1	10	585	Peerless
1	10	1325	Peerless
1	7½	700	O'Donnell
1	7½	1400	Lincoln
1	7½	1500	Phoenix
1	6	550/1100	Peerless
1	5	700	Lincoln
1	3½	1100	G. E.
1	3	1750	Sprague
1	2½	490/650	Allis-Chalmers
1	2	750	Westinghouse
1	1	1275	Westg.
1	1	1650	Bissell
1	1	1700	G. E.

110 VOLT D. C. MOTORS

1	15	650	Sprague
1	10	300/1000	Jantz-Leist
1	10	1750	Colburn
1	6	560	Card
1	3	600	Lincoln

GENERATORS

Qu.	Kw.	Speed	Volts	Make
1	10	800	110	Sprague
1	30	1150	250	Crocker-W.
*1	40	975	125	Akron
*1	60	810	125	Triumph
1	75	700	250	G. E.
*1	100	600	250	Westg.
1	100	700	250	G. E.

MOTOR GENERATOR SETS

100-kw., 250-volt, 600-r.p.m., USED Westinghouse, D.C. Generator, with field rheostat, flexibly coupled to 150-hp., 440-volt, 3-phase, 60-cycle, 720-r.p.m., USED Western Electric motor, with starting compensator.

75-kw., 250-volt, 700-r.p.m., USED General Electric, D.C. Generator, with field rheostat, flexibly coupled to 150-hp., 440-volt, 3-phase, 60-cycle, 720-r.p.m., USED Western Electric motor, with starting compensator.

30-kw., 250-volt, 1150-r.p.m., USED Crocker-Wheeler, D.C. Generator flexibly coupled to 40-hp., 220- or 440-volt, 3-phase, 60-cycle, 1165-r.p.m., NEW General Electric motor with starting compensator

10-kw. 110-volt, 865-r.p.m., USED Sprague, D.C. Generator, with switchboard, flexibly coupled to 15-hp., 220- or 440-volt, 3-phase, 60-cycle, 865-r.p.m., NEW General Electric motor, with starting compensator.

3-PHASE 60-CYCLE MOTORS

H.P.	Speed	Make	Volts 220	440
150	720	Western		1
*75	450	G. E.		2
35	900	Western	1	
30	1150	Westg.	1 slip ring	
20	1730	Wagner	1	
20	1800	G. E.	1	
20	1800	Lincoln	1	
15	1150	Allis-C.		1
15	1720	Wagner		1
10	1800	G. E.	1	
7½	900	G. E.	1	
7½	1800	G. E.	1	
7½	1800	Western	1	

*Detroit stock.

ALTERNATORS

150-kva., 220-volt, 3-phase, 60-cycle, 900-r.p.m., USED Westinghouse, A.C. Alternator, with pulley, rails, field rheostat and exciter.

30-kva., 220-volt, 3-phase, 60-cycle, 1200-r.p.m., USED Burke, A.C. Alternator, with pulley rails, field rheostat and exciter.

*Detroit stock.

We maintain a large and up-to-date repair shop and can give you prompt service. Our night telephone numbers are: Marlo 234-M, Eddy 6001-R. Being jobbers for Electrical supplies, we solicit your inquiries.

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FIRST NATIONAL BANK BLDG. ELECTRIC AND STEAM MACHINERY CINCINNATI, OHIO U.S.A.

A-1 POWER APPARATUS—IMMEDIATE DELIVERY

BOILERS

4—350-hp. Stirling, Class N, No. 16, butt joint, triple riveted, 190 lb., Foster superheaters, complete plant.
1—500-hp. B. & W., steel header, butt joint, 185 lb., B. & W. stoker.
1—400-hp. Stirling, butt joint, complete with superheater and stack, 160 lb.
10—500-hp. B. & W., steel header, 160 lb., oil furnaces.
3—500-hp. B. & W., steel header, 200 lb.
3—250-hp. Heine, 125-150-lb., hand fired.
1—600-hp. B. & W., 115 150-lb.
1—500-hp. B. & W., 115 150-lb.
1—400-hp. B. & W., 122-160-lb.
4—250-hp. B. & W., 150-lb.
2—150-hp. Lynne, 150-lb. allowance, vertical water tube.

D. C. UNITS

1—400-kw. Bullock, 230-volt, direct connected to Allis-Chalmers, cross compound, heavy duty Corliss engine.
1—300-kw. General Electric, 250-volt, M.P. 10, direct connected at100 rev., tandem compound, heavy duty Corliss engine.
1—300-kw. Western Electric, 240-volt, direct connected at 180 rev., to Williams valve vertical cross compound engine.
1—250-kw. Western Electric, 250-volt, M.P.8, direct connected at 180 rev., Ideal tandem compound engine.
1—200-kw. Crocker-Wheeler, 250-volt, direct connected to left hand, heavy duty Corliss engine.
1—200-kw. Crocker-Wheeler, 125-volt, M.P.8, direct connected at 150 rev., 18 x 32 Corliss engine, practically new.
2—150-kw. Bullock, 250-volt, M.P.6, direct connected to Ames left hand automatic engines.
1—150-kw. Western E ectric, 220-vo t, direct connected at 225 rev. to Ideal Simple Automatic engine.

A. C. UNITS

1—1000-kw. General Electric, A.T.B. Alternator, 2300-volt, 120 rev., with vertical Rice & Sargeant engine.
1—600 kw. General Electric, A.T.B. alternator. 2300 volt. 150 rev. with vertical Rice & Sargeant engine.
2—600-kw. General Electric, H. D. Alternator, 60-cycle, 3-phase, 2300-volt, with cross compound Rie & Sargeant engines.
1—500-kw. Fort Wayne, R. F. Alternator, 60-cycle 3-phase, 2300-volt, 120-rev., with heavy duty Hamilton Corliss engine.
1—240-kw. Stanley R. F. Alternator, 2300-volt, 125-rev., with Buckeye automatic engine.
1—170-kw. Fort Wayne, R. F. Alternator, with compound Russell engine.
1—150-kw. General Electric, A.T.B. Alternator, 225-rev., with Ideal tandem engine.

A.C., D.C. UNITS

3—800-kw. General Electric, 25-cycle, 3-phase, A.T.B. Alternators, 370-400-volt, with cross compound Hamilton Corliss engines.
1—625-kva. Crocker-Wheeler Revolving Field Engine Type Alternator, 60-cycle, 3-phase, 220-440-volt, 225-rev., no engine.
2—300-kw. Westinghouse R.F. Engine Type Alternators, 25-cycle, 3-phase, 400 volt, with cross compound Hamilton Corliss engines.

TURBINES

1—15,000-kw. General Electric Horizontal Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt.
2—10,000-kw. Allis-Chalmers-Parsons Turbo-Alternator Unit, 25-cycle, 3-phase, 6600-volt, 1500-r.p.m.
1—9300-kva. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, with jet condenser.
1—5000-kva. General Electric Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, 1200-r.p.m.
1—3750-kva. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, with jet condenser.
1—2000-kw. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2400 vo t, 1200-r.p.m.
2—2000-kw. General Electric Turbo Generator Units, 60-cycle, 3-phase, 2300-volt, 3600-r.p.m., direct connected to Curtis steam turbines for 150- b. steam pressure.
1—1500-kw. Westinghouse-Parsons Horizonta Condensing Turbo Alternator, 60-cycle, 3-phase, 440-2300-4400-volt, comp ete with condenser.
2—1500-kw. Allis-Chalmers Condensing Turbo Alternator Units, 60-cycle, 3-phase, 6600-volt, with surface condensers.
2—750-kw. General Electric, Type A.T.B., 60-cycle, 3-phase, 2300-volt Generator, direct connected to Form B, non-condensing Curtis 160- b. steam pressure Turbine.
1—300-kw. Westinghouse-Parsons Condensing Turbo Alternator Unit, 60-cycle, 3-phase, 2300-volt.

FREQUENCY CHANGERS

1—1000-kw. Westinghouse, 60-cyice, 3-phase, 2300-volt to 30-cycle, 6600-volt.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4000-volt Alternator, with 700-hp., 25-cycle, 13000-volt motor.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4100-volt Alternator, with 800-hp., 25-cycle, 9000-volt motor.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4000-volt Generator, with 25-cycle, 3-phase, 2300-4000-volt motor.

BELTED D.C. UNITS

2—400-kw. Westinghouse, belted M.P.6, 3 bearing 250-volt, 375-r.p.m.
150-200-250-300-kw. belted Multipolar Generators, with and without Corliss and automatic engines for belted drive.
Heavy Duty Corliss, automatic and four-valve Engines, ranging in size from 100 to 5000-hp. capacity.

A. C. MOTORS

1—1200-hp. General Electric, 25-cycle, 3-phase, 2200-volt, 250-r.p.m. Induction Motor; shaft extension both ends.
1—1200-hp. General Electric, 60-cycle, 3-phase, 2300-volt, 2—60-r.p.m. Synchronous damper wound Motor, with starting device. No bearings or pulley.
1—250-hp. Burke, 60-cycle, 2-phase, 2300-volt, Synchronous Slip Ring Motor, with twin, 24-in. Platt Iron Works Pump; 20 million G.P.D., 45-ft. head.
5—240-hp. General Electric, 25-cycle, 3-phase, 6600-volt, 500-r.p.m. Synchronous Motors.

SHOVEL

1—45-ton Steam Shovel, Class 2, car length 30 ft.; width 9 ft.; will dump 22 ft. from center of mast each way 1¼ cu.yd. capacity.

COMPLETE PLANTS BOUGHT and SOLD

WE HAVE FOR IMMEDIATE DELIVERY

3-Phase, 220-440-Volt

2—500-hp. Allis-Chalmers, mill type, 900-r.p.m.
2—200-hp. Crocker-Wheeler, 117Q.
2—125-hp. Crocker-Wheeler, 125 AQ, 690-r.p.m
1—100-hp. General Electric, E-10, 720-r.p.m.
3—100-hp. Westinghouse, 870-r.p.m.
3—100-hp. Crocker-Wheeler, 35 R, 1750-r.p.m.
2— 75-hp. Lincoln, C-14, 1800-r.p.m.
1— 60-hp. Burke, I-M, 1800-r.p.m.
2— 75-hp. Crocker-Wheeler, 125-Q, 575-r.p.m.
1— 60-hp. Crocker-Wheeler, 123 AQ, 680-r.p.m.
2— 50-hp. Westinghouse, CCL, 720-r.p.m.
3— 50-hp. Allis-Chalmers, 3K, 690-r.p.m.
2— 50-hp. Crocker-Wheeler, 122Q, 665-r.p.m.
4— 50-hp. Crocker-Wheeler, 121Q, 1160-r.p.m.
2— 50-hp. Fairbanks-Morse, BB, 1200-r.p.m.
4— 50-hp. Fairbanks-Morse, 16A, 720-r.p.m.
3— 40-hp. General Electric, KT, 1800-r.p.m.
2— 40-hp. Crocker-Wheeler, 121Q, 865-r.p.m
3— 40-hp. Crocker-Wheeler, 122Q, 685-r.p.m.
2— 35-hp. Westinghouse CL, 870-r.p.m.
4— 35-hp. Crocker Wheeler, 120Q, 850-r.p.m.
3— 30-hp. Westinghouse, C, 1150-r.p.m.
5— 30-hp. Fairbanks-Morse, 12B, 1200-r.p.m.
6— 25-hp. Crocker-Wheeler, 118Q, 1150-r.p.m.
3— 25-hp. Crocker-Wheeler, 119Q, 850-r.p.m.
20— 25-hp. Fairbanks-Morse, 12A, 1200-r.p.m.
4— 20-hp. Fairbanks-Morse, 12B, 900-r.p.m.
3— 20-hp. Crocker-Wheeler, 117Q, 1140 r.p.m.
3— 20-hp. Crocker-Wheeler, 116Q, 1739-r.p.m.
5— 15-hp. Westinghouse HF, 690-r.p.m.
4— 15-hp. Western Electric, L-10, 665-r.p.m.
4— 15-hp. General Electric, K, 900-r.p.m.
12— 15-hp. Crocker-Wheeler, 116Q, 1130-r.p.m.
3— 15-hp. Fairbanks-Morse, 10-C, 100-r.p.m.
3— 15-hp. Wagner, BW, 1140-r.p.m.
3— 20-hp. Westinghouse, CS, 1160-r'p.m.
2— 25-hp. General Electric, I, 900-r.p.m.
30— 10-hp. Crocker-Wheeler, 115Q, 1130-r.p.m.
7— 10-hp Fairbanks-Morse, 10 B, 1200-r.p.m.
3— 10-hp. Allis-Chalmers, 3K, 1730-r.p.m.
14— 7½-hp. Westinghouse, CS, elevator, 980-r.p.m.
3— 7½-hp. Crocker-Wheeler, 117-Q, 560-r.p.m.
2— 11-hp. Westinghouse CI, elevator, 1135-r.p.m.
15— 5-hp. Crocker Wheeler, 105Q, 680-r.p.m.
10— 5-hp. Crocker-Wheeler, 113Q, 1140-r.p.m.
5— 5-hp. Westinghouse CS, 1735-r.p.m.
4— 3-hp. Crocker-Wheeler, 109Q, 1140-r.p.m.
3— 3-hp. Crocker-Wheeler, 114AQ, 690-r.p.m.
15— 3-hp. Crocker-Wheeler, 111Q, 1130-r.p.m.
5— 2-hp. Crocker-Wheeler, 111Q, 835-r.p.m.
8— 1-hp. General Electric, KT, 1800-r.p.m.
6— 1-hp. Crocker-Wheeler, 104Q, 1710-r.p.m.

General Electric, Westinghouse, Fairbanks-Morse and Crocker-Wheeler

2-Phase, 220-440 Volt

4— 1-hp., 1200-r.p.m.
3— 1-hp., 1700-r.p.m.
2— 1-hp., 900-r.p.m.
4— 2-hp., 850-r.p.m.
5— 2-hp., 1730-r.p.m.
6— 3-hp., 850-r.p.m.
5— 3-hp., 1150-r.p.m.
5— 3-hp., 1730-r.p.m.
7— 7-hp., 1130-r.p.m.
5— 7-hp., 1720-r.p.m.
4—10-hp., 1130-r.p.m.
3—15-hp., 1130-r.p.m.
6— 15-hp., 850-r.p.m.
3— 20-hp., 1200-r.p.m.
5— 25-hp., 1150-r.p.m.
4— 25-hp., 850 r.p.m.
6— 35-hp., 900-r.p.m.
5— 40-hp., 1160-r.p.m.
10— 50-hp., 900-r.p.m.
7— 75-hp., 1160-r.p.m.
8—100-hp., 720-r.p.m.
5—125-hp., 705-r.p.m.
6—200-hp., 580-r.p.m.
5—200-hp., 870-r.p.m.

Single-Phase, 110-220 Volt

5— ¼-hp. Westinghouse, 850-r.p.m.
3— ½-hp. Ideal, 1165-r.p.m.
4— 1 -hp. Century, 1165-r.p.m.
5— 2 -hp. Century, 1750-r.p.m.
4— 2 -hp. Westinghouse, 1700-r.p.m.
3— 3 -hp. Westinghouse, 1720-r.p.m.
6— 3 -hp. Century, 1165-r.p.m.
5— 3½-hp. Century, 1165-r.p.m.
3— 7½-hp. Westinghouse, 1720-r.p.m.
2—10 -hp. Wagner, 1720-r.p.m.

D.C., 220 and 440 Volt

50-hp. Crocker-Wheeler, 450-r.p.m., Type CCM
50-hp. Westinghouse, 750-r.p.m., type S.K.
40-hp. C. & C. Interpole, 955-r.p.m.
30-hp. Reliance, 730-r.p.m.
30-hp. Reliance, 1700-r.p.m.
25-hp. Westinghouse, 825-r.p.m., type S.K.
20-hp. Reliance, 1700-r.p.m., type R.G.
20-hp. General Electric, 1150-r.p.m.
15-hp. Westinghouse, 1100-r.p.m., type SK
15-hp. General Electric, 1700-r.p.m., type R.G.
15-hp. Westinghouse, 1700-r.p.m.
10-hp. Westinghouse, 850-r.p.m., type S.K.
10-hp. Genera lElectric, 1700-r.p.m., type R. C.
10-hp. General Electric, 1150-r.p.m., type R.G.
10-hp. Westinghouse, 1150-r.p.m., type SK
7½-hp. Westinghouse, 850-r.p.m., type S.K.
7½-hp. General Electric, 1150-r.p.m., type R.G.
7½-hp. Westinghouse, 1700-r.p.m., type S.K.
5-hp. Westinghouse, 1800-r.p.m., type S.K.
5-hp. Westinghouse, 1200-r.p.m., type S.K.
5-hp. General Electric, 1150-r.p.m., type R.G.
5-hp. General Electric, 850-r.p.m., type S.K.
3-hp. Westinghouse, 1725-r.p.m., type G.D.
3-hp. General Electric, 1150-r.p.m., type R.G.
2-hp. Westinghouse, 1725-r.p.m., type G.D.
2-hp. Westinghouse, 1180-r.p.m., type GD

D.C., 500-Volt

1—5-hp. Crocker-Wheeler, series, with controller for hoist, 1340-r.p.m.
1— 7½-hp. General Electric, type CVC, Interpole, 825-r.p.m.
1—10-hp. Westinghouse, type S, 1200-r.p.m.
1—15-hp. Westinghouse, type M, 1050-r.p.m.
1— 8-hp. Westinghouse, type S, 900-r.p.m.

Direct-Connected Units 110-Volt, D. C.

1—30-kw. Western Electric, with Buckeye steam engine.
1—35-kw. Fairbanks-Morse, with Fairbanks-Morse 2-cyclinder vertical gas engine.
1—50-kw. American Ball Generator and Steam Engine.
1—9-kw. Westinghouse, with 2-cylinder, vertical Bruce MacBeth.

250-Volt

2—175-kw. Ridgway Dynamo & Engine Co. Generator and Steam Engine.
2—225-kw. Westinghouse Generators, with Koerting gas engines.
Also have a number of **Turbo Generator Units,** from 300-kva. to 3000-kva., 480- and 2300-volt, 3-phase, 60-cycle; direct connected two- and three-phase generators with reciprocating steam and gas engines.
Gas Engines, 5000-hp. in various sizes to 750-hp.
Boilers, 30,000-hp. in various sizes to 612-hp.
Air Compressors, large assortment, sizes to 2500-cu.ft.

W. A. CARRELI & CO 211-213-215 Second Avenue, Pittsburgh, Pa.

FIRST-CLASS USED EQUIPMENT

Immediate Release

1—2000-2500-kw. G. E., 1800 r.p.m., 150-lb. pressure, 3-ph., 60-cy., 2300-volt horizontal **Steam Turbo Generator**—6000 sq.ft. C. H. Wheeler surface condenser, with engine driven aux.

2—500-hp. **Porcupine Boilers,** Mass. std., 160-lb. pressure, 6 years old. Universal chain grate, steel casing, individual stacks.

1—2000-hp. "Hoppes" open type **Feed Water Heater.**

1—2000-hp. "National" closed type **Feed Water Heater.**

1—200 GPM 3-in. Jeansville-Terry cent. D. S. **Pump.**

1—9-in. x 6-in. x 12-in. duplex, outside, center packed **Blake Pump.**

1—20-kw. G. E., 900 r.p.m., 2300-volt, motor driven, 125-volt **Exciter.**

1—**G. E. Tirrell Regulator,** 2886-TA-125-F-6, mounted on 16 x 31 x 1½ inches, black slate.

Greenfield Electric Light & Power Co.
Greenfield, Mass.

For Sale—Immediate Delivery

f.o.b. cars Baltimore, Md.

STEAM ENGINES

2—125-hp. 13 x 13 Harrisburg.
1—215 hp. 14 x 16 Ames.
1—210-hp. 16 x 14 Ball.

MOTOR GENERATOR

1—Synchronous Motor Generator Set consisting of 700 hp. Synchronous Motor, Type ATI, 25-cycle, 13,000-volt, 750 r.p.m., Form C, and 1 A. C. 500-kw., Type ATB, 60-cycle, 4000-volt, and direct current exciter type M.P., 125-volt. Three units mounted on one shaft with two bearings.

PUMPS

1—Simplex 3½-in. x 6-in. motor driven reciprocating pump with extended base with Westinghouse ½-hp. Type C 1200 r.p.m. Motor C. D. 1200 r.p.m. Motor.
1—Hill 2-in. Double suction Centrifugal Pump, with extended base. Capacity 75 G.P.M. against 125-ft. head.

NEW WESTINGHOUSE TRANSFORMERS

6—100-kva. Type S.C., 13,200-v. H.T., with 4—2½ H.T. Taps, 460 v., L. T. Single-phase, 25-cycle.
3—200-kva. Type S.C., 13,200-v. H. T., 2—5% Taps, 1-phase, 25-cycle, 460-230-v. L. T.
3—833-kva. O. I. S. C., 13,200-v. H. T., 4—2½% Taps, 1-phase, 25-cycle, L. T., 440 volts.

MISCELLANEOUS

1—New York Air Brake Compressor No. 2145 for 90 lb. pressure. Compressor end double action 7 in. x 9 in. delivering approximately 40 C. F. Air at 60 lb. pressure.
1—Patterson Automatic Steam damper regulator complete with brackets and weights.
2—160-hp. Terry Turbines, direct connected to No. 10 Sturtevant blowers.

Purchasing Agent
Consolidated Gas, Elec. Light and Power Co.
Baltimore, Md.

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500-VOLT DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	Speed
1	7½	General Electric—NEW	BGR	850
1	7½	Westinghouse	SK	850
3	7½	Westinghouse	SK	1150
1	7½	Westinghouse	SK	1750
8	7½	General Electric—2 compd.	RC	900
4	7½	General Electric	RC	1300
7	7½	General Electric	CVC	1125
1	7½	General Electric	CVC	1685
1	10	Westinghouse	SA	435/1300
2	10	Westinghouse	SK	1200
1	10	Westinghouse	SK	850
1	10	Westinghouse	SK	1300
1	10	Westinghouse		1250
1	10	Allis-Chalmers		900
4	10	General Electric	RC	900
1	10	General Electric	RC	1800
1	10	General Electric	CVC	1500
1	15	General Electric	RC	1250
2	15	General Electric	CVC	1350
1	15	Westinghouse	SK	825
3	15	Westinghouse	SK	1100
4	15	Westinghouse	SK	1700
1	20	Westinghouse	SK	1100
1	20	Westinghouse	SK	1700
1	20	General Electric	CLA	690
5	25	Crocker-Wheeler—compd.	CCM	780
6	25	Westinghouse	S	950
3	25	General Electric	DLC	875
1	25	General Electric	CVC	1700
1	30	Westinghouse	SK	1700
1	30	Westinghouse	R	
2	30	General Electric		1250
2	30	General Electric	RC	1250
2	35	General Electric	MP	600
1	35	General Electric	DLC	825
4	35	General Electric		850
3	35	Crocker-Wheeler—compd.	CCM	730
4	40	Westinghouse	SK	600
3	40	General Electric	RLC	600/1200
2	40	General Electric	RLC	1200
5	48-80	Westinghouse	SK	550/800
4	50	Westinghouse	SK	750
1	50	General Electric	DLC	750
1	50	Westinghouse	SK	975
2	50	Westinghouse	SA	550
2	65	Westinghouse—compd.	SA	825
3	70	General Electric	RLC	1100
1	75	Bullock		825
1	75	Westinghouse	SK	850
1	80	Westinghouse	SA	600/900
4	90	General Electric		1025
1	100	Westinghouse	S	685
1	105	General Electric	CLB	700
1	115	General Electric	DLC	975
2	150	General Electric—series, crane or hoist	GE-211	700

GEORGE SACHSENMAIER CO.
OFFICE AND SALESROOMS: 141-43-45 W. 3rd St.
WAREHOUSE AND SHOP: 928-30-32 W. 3rd St.
PHILADELPHIA, PA.
Let us know what you have for sale.

"The Machinery House of the East"

FRANK TOOMEY, Inc.

1876 **1876**

DIRECT-CURRENT MOTORS
220-250 VOLTS

165-hp. Crocker-Wheeler, type CCM, Interpole, 670 r.p.m.
90-hp. Westinghouse, type M, 650 r.p.m.
50-hp. Westinghouse, type M, 675 r.p.m.
45-hp. Diehl Interpole 600 r.p.m.
40-hp. Allis-Chalmers 550 r.p.m.
25-hp. Westinghouse type SK Interpole 950 r.p.m
25-hp. Bullock 775 r.p.m.
15-hp. General Electric, type CE, 1200 r.p.m.
15-hp. Bullock, 1300 r.p.m.
15-hp. Peerless, 1150 r.p.m.
10-hp. Allis-Chalmers, 1300 r.p.m.
7½-hp. Crocker-Wheeler 1100 r.p.m.
7½-hp. General Electric, 1600 r.p.m.

DIRECT-CURRENT MOTORS
110-125 VOLTS

50-hp. Bullock, 850 r.p.m.
32-hp. Crocker-Wheeler, type CCM, 1000 r.p.m.
30-hp. Kinetic, 1100 r.p.m.
25-hp. Crocker-Wheeler, type CCM, 750 r.p.m.
20-hp. General Electric, type CQ, 925 r.p.m.
20-hp. General Electric, type CQ 1150 r.p.m.
15-hp. Crocker-Wheeler, type CCM, 800 r.p.m.
15-hp. Bullock, 1350 r.p.m.
2—10-hp. General Electric type RC, Interpole, 850 r.p.m.
4—10-hp. Crocker-Wheeler, type CCM, 825 r.p.m.
7½-hp. Crocker-Wheeler, 1100 r.p.m.
7½-hp. General Electric, type CE, 1800 r.p.m.

Large stock of Alternating and Direct Current Motors. Immediate shipment.

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PHILADELPHIA, PA.

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165-7 Grand Street, N. Y.

We have or may have

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Write or phone

Partial list of 2-ph. motors, 220-volt, 60-cycles, squirrel cage Wagner motors.

SLIP RING, VARIABLE SPEED

Qu.	HP.	RPM.	Make
2	3	850	Wagner
1	5	1140	"
1	5	1720	"
1	7½	1720	"
1	10	850	"
2	15	850	"
3	11	850	West. 3 ph.
2	11	600	"
2	15	845	"
2	15	600	"

G. E., 3 ph., 1200 RPM		
Qu.	HP.	
2	35	Form L
2	30	" L
2	30	" B
2	20	" L
1	25	" B
1	50	Wagner

HAROLD R. WILSON MACHINERY CO.
Electric and Steam Machinery Second Hand
Federal Reserve Bank Building, ST. LOUIS, MO.

DIRECT CONNECTED D.C. UNITS 125-250 VOLTS

Kw.	Make	Volts	Poles	Sp.	Make Engine
2—500	Burke	250	..	150	22&38x27 Erie Ball, 4 Va.
500	C. W.	250	16	125	22&38x36 Ironton Corliss
400	Allis	250	..	..	Allis Corliss Cross Compound
300	G. E.	250	10	100	16&32x36 Corliss T. C.
300	Westge.	550	..	125	22x36 Corliss
300	C. W.	250	..	150	20x42 Corliss
300	G. E.	250	8	185	20&34x18 B. & W., 4-valve
250	Westge.	250	8	180	19 and 32x20 Ideal
2—175	McEwen	250	..	200	19x20 McEwen
160	G. E.	250	..	230	14 and 26 x 16 Harrisburg
3—150	Allis	250	..	....	16x24 3-cyl. Diesel Oil
150	Westge.	250	..	200	20x24 Erie Ball
125	G. E.	250	6	250	10 and 20x15 Au.omatic
3—100	Goughnour	250	..	265	14x15 Skinner
100	T. R.	250	..	..	McEwen Simple
75	Westge.	250	..	250	11x12 Westge. Gas Eng.
75	G. E.	230	..	2400	Curtiss Turbine
75	Westge.	250	..	270	14x14 Payne Automatic
75	W. E.	250	6	275	14 x 13 Chuse Automatic
50	G. E.	125-250	..	300	16 x 14 Harrisburg

ENGINES—BOILERS—A.C. & D.C. MOTORS, GENERATORS
This is only a partial list

IMMEDIATE DELIVERY

MOTORS

1—300 hp. Crocker-Wheeler 3 ph., 2300-v. 60-cy. 600 r.p.m. Slip-ring type motor only.
3—75 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
1—75 hp. General Electric, 2 ph., 220-v. 60-cy. 900 r.p.m. Slip-ring type complete.
4—50 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m.
4—50 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
1—35 hp. General Electric, 220-v. Direct Current, 560 r.p.m.
1—30 hp. Triumph, 2 ph., 220-v. 60-cy. 1140 r.p.m.
4—25 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
3—25 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—25 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m.
1—20 hp. General Electric, 3 ph., 550-v. 60-cy. 900 r.p.m.
1—20 hp. General Electric, 3 ph., 220-v. 60-cy. 1200 r.p.m.
3—20 hp. General Electric, 2 ph., 220-v. 60-cy. 1200 r.p.m.
5—20 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
5—15 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—15 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1800 r.p.m.
1—15 hp. Westinghouse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—15 hp. General Electric, 2 ph., 220-v. 60-cy. 1200 r.p.m.
1—15 hp. Sturtevant Direct Current, 125-v. 150/450 r.p.m. (shunt interpole).
1—15 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m. (slip-ring).
1—15 hp. Fairbanks-Morse, DC, 230-v. 1100 r.p.m.
4—10 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
4—10 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
Single Phase Wagner motors, 5 to 20 hp. type BA in stock.

GENERATORS

1—100 Kw., G. E. 125-v. DC direct connected to a Ball & Wood engine, complete with switchboard.
1—75 Kw., Crocker-Wheeler AC Generator, 2 phase, 220 volt, 60 cycle, 900 r.p.m. with direct connected exciter, complete with switchboard.
1—60 Kw. Stanley 2 ph., 60-cy. 900 r.p.m. with exciter and switchboard.
1—50 Kw., Western Electric generator 126-v. DC 265 r.p.m. 6-pole compound direct connected to an Ideal centercrank Harrisburg engine, complete with switchboard.
2—30 Kw., Westinghouse 125-v. DC direct connected to an American Ball engine complete with switchboard.
1—25 Kw., Crocker-Wheeler 125-v. DC direct connected to an American-Ball engine complete with switchboard.

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BROWN-HUNKELE CORPORATION, 12-24-26 Mechanic Street, Newark, N. J.

For Quick Sale!—Ready Now!

GENERATORS AND MOTORS

1—125 Kva. Allis-Chalmers Generator, 2400 V., 3 P., 60 C., direct connected to Brownell Auto. Engine, complete with Switchboard.
1—150 Kw. Triumph, 250 V. D.C. Generator, direct connected to 16 in. x 21 in. Chuse Corliss Valve Engine.
1—150 H.P. Fairbanks, Morse, 440 V., 3 P., 60 C.
1— 30 H.P. Crocker-Wheeler, 220 V., 3 P., 60 C.
1— 20 H.P. G.E., 220 V., 3 P., 60 C.
1— 20 H.P. Fairbanks, Morse, 220 V., 3 P., 60 C.
1—200 H.P. Crocker-Wheeler, 150 V. D.C.
1— 10 H.P. Crocker-Wheeler, 115 V. D.C.
1— 10 H.P. Western Electric, 110 V. D.C.
1— 5 H.P. Triumph, 110 V. D.C.
2— 5 H.P. Bullock, 120 V. D.C.

CONVERTERS AND TRANSFORMERS

1—300 K.W. G.E. Rotary Converter, 25 C., 600 V.
3—110 K.W. G.E. Transformers, 25 C., 13,200 to 185 V. Oil Cooled.
3—200 K.W. Westinghouse Transformers, 25 C., 11,500 to 440 V. Oil Cooled complete with panel board and all instruments.
1—Complete set of Lightning Arresters.
3—10 K.W. Kuhlman Transformers, 25 C., 440 to 110 V. Oil Cooled.

COPPER WIRE

10,000 ft. 400,000 C.M. Stranded Bare Copper Wire.
50,000 ft. 350,000 C.M. Stranded Bare Copper Wire.
10,000 ft. of No. 4-0 Grooved Copper Trolley Wire.
15,000 ft. of No. 6 Rubber Covered Copper Wire.
10,000 ft. of No. 4 Rubber Covered Copper Wire.
10,000 ft. of No. 0 Rubber Covered Stranded Copper Wire.
10,000 ft. of No. 0 Weatherproof Stranded Copper Wire.

COMPRESSORS

2—310 ft. Capacity 12 in. x 12 in. Bury Single Cyl. Belt Driven Air Compressors, 100 lb. pressure.
2—250 ft. Cap. 14 in. x 9 in. x 8 in. Bury Compound Air Cyl. Belt Driven Air Compressors, 100 lb. pressure.
1—450 ft. Cap. 16¾ in. x 10¾ in. x 12 in. Ingersoll Compound Air Cyl., Belt Driven Air Compressor, 100 lb. pressure.
1—350 ft. Cap. 14 in. x 14 in. x 16 in. Chicago Pneumatic Steam Driven Compressor, 100 lb. pressure.

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Electric Motors
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Any Idle Equipment

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NATHAN KLEIN & CO.
MOTORS CENTRE & HOWARD STS., N.Y. DYNAMOS

LARGE SLIP RING MOTORS

For Immediate Delivery

1—50-hp., 3-phase, 60-cyc., 2200-v., 900 r.p.m.
1—75-hp., 3-phase, 60-cyc., 2200-v., 900 r.p.m.
1—100-hp., 3-phase, 60-cyc., 220/440-v., 900 r.p.m.
1—150-hp., 3-phase, 60-cyc., 220/440-v., 600 r.p.m.
1—200-hp., 3-phase, 60-cyc., 2200-v., 600 r.p.m.

300 kw., 3 bearing belt driven railway generator, 435 r.p.m.

LEO A. PHILLIPS
90 West St., New York City

TURBO GENERATORS

1—500-kw., 60-cycle, 2 or 3-phase, 2300-volt Horizontal Westinghouse, in fine condition.
1—50-kw. Westinghouse, Direct Current, 125-250 v.
200-kw. Mixed Pressure Turbo Alternator.
300-kw. Synchronous Motor Generator Set.

WILLIAM P. BREW
120 Broadway, New York, N. Y.

550-VOLT, D. C. MOTORS

At Unusually Low Prices

4—2 H. P. R. C. Gen. Elec., 1300 R. P. M.
4—5 H. P. S. K. Westghe., 1200 R. P. M.
5—5 H. P. C. V. C. Gen. Elec., 1300 R. P. M.
1—7½ H. P. C. V. C. Gen. Elec., 1125 R. P. M.
2—10 H. P. R. C. Gen. Elec., 1250 R. P. M.
1—15 H. P. S. K. Westghe., 675 R. P. M.
1—15 H. P. R. C. Gen. Elec., 1250 R. P. M.
1—20 H. P. S. K. Westghe., 1100 R. P. M.
1—25 H. P. S. K. Westghe., 1100 R. P. M.
2—25 H. P. Burke, 900 R. P. M.
1—35 H. P. S. K. Westghe., 850 R. P. M.
1—40 H. P. S. K. Westghe., 600/1200 R. P. M.
1—50 H. P. S. K. Westghe., 750 R. P. M.
1—65 H. P. R. L. C. Gen. Elec., 400/800 R. P. M.

35 KW. 110-volt De Lavalle Turbo Set.
3½ KW. Fairbanks-Morse direct-connected set, gas or gasoline.
All makes, types, voltages of dynamos and motors.

R. SCHEINERT COMPANY
123-25 N. Third Street, Philadelphia, Pa.

IN OUR WAREHOUSE

Immediate Shipment

1—150 HP., 3-phase, 220 volt, General Electric, 575 RPM.
1—150 HP., 2-phase, 220 volt, Westinghouse, 690 RPM., slip ring.
2—100 HP., 3-phase, 440 volt, Westinghouse, 870 RPM., slip ring.
1—125 HP., 2-phase, 220 volt, Westinghouse, 535 RPM., slip ring.
2— 50 HP., 2-phase, 220 volt, Westinghouse, 870 RPM., slip ring.
1— 40 HP., 3-phase, 220 volt, Fairbanks-Morse, 720 RPM., slip ring.
1— 30 HP., 3-phase, 220 volt, Westinghouse, 865 RPM., slip ring.
1— 30 HP., 2-phase, 220 volt, Westinghouse, 865 RPM., slip ring.
1— 25 HP., 2-phase, 220 volt, Fairbanks-Morse, 900 RPM, slip ring.
1— 20 HP., 2-phase, 220 volt, Westinghouse, 900 RPM., slip ring.
1— 50 HP., 3-phase, 220 volt, Wagner, 1800 RPM., slip ring.

All sizes of squirrel cage, 2 or 3-phase, from 1 to 150 HP. in stock. If you want direct current motors we have them.

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300 Kw. D. C. GENERATOR

Brand new, slightly used. Less than half price. Also

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A Few Selections From Our Large Stock

CORRECT PRICES AND PROMPT SERVICE

Quan.	Make	Hp.	Type	Ph.	Volt	R.p.m.	Cy.	Condition
1	Allis-Chalmers	15	.....	2	220	1200	60	Good
1	Westinghouse	15	CS	2	220	1200	60	Good
2	Westinghouse	25	CS	2	220	1200	60	New
1	Wagner	25	BR	2	220	1140	60	Good slip rg.
1	Allis-Chalmers	30	3K	2	220	860	60	Good
1	Crocker-Wheeler	7½	114Q	3	220	1130	60	New slip rg.
1	Crocker-Wheeler	10	114Q	3	220	1710	60	New slip rg.
1	Allis-Chalmers.....	10	B	3	220	1200	60	Good slip rg.
2	Westinghouse	15	KT	3	220	1200	60	New
1	Crocker-Wheeler	15	118Q	3	220	675	60	New
1	Crocker-Wheeler	15	KT	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	1200	60	Good
1	Crocker-Wheeler	20	116Q	3	440	1720	60	New
1	General Electric	20	I	3	220	1200	60	Good
1	Western Electric	20	KT	3	220	900	60	New
1	Crocker-Wheeler	25	25R	3	440	720	25	New
1	Westinghouse	25	CS	3	220	1160	60	New
1	Westinghouse	30	CS	3	220	870	60	New
1	Crocker-Wheeler	35	118Q	3	220	1750	60	New slip rg.

DAVIS MACHINE & MOTOR CO.

Telephone—Market 8580 — 59 Mechanic St., Newark, N. J.

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A. C. GENERATORS

37½-kw., 3-ph., 2300-v. Belted to Mogul desolate engine.
100-kw., 3-ph., 220-v. General Electric complete.
100-kw., 3-ph., 2300-v. Allis-Chalmers complete.
160-kw., 3-ph., 220-v. General Electric complete.
200-kw., 3-ph., 2300-v. General Electric complete.
750-kw., 3-ph., 480-v. Curtis Turbo units.
1000-kw., 3-ph., 480-v. Allis-Chalmers connected to Allis-Chalmers cross compound engine.

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32-kw., 125-v. Triumph direct connected to 50-hp. Mogul desolate engine.
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150-kw., 250-v. Fort Wayne belted generator complete.

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1—25 Kw. 125-volt, **Eng. Driven D.C. Set** 150 lb. steam pressure.

5—250 Kva. 4—150 Kva. 5500-volt—2400-volt—60-cycle oil cooled **Transformers.**

90—**Current Transformers** from 50 to 1000 amps. primary—2500 to 15,000 volts.

65—**Disc Switches,** 500 to 2000 amps.—7500 to 15,000 volts.

6—100 amp. **2300 Feeder Regulators.**

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Various instruments, indicating and curve drawing.

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BELYEA COMPANY - - 48-50 E. 8th St., New York City

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25—2 and 3 hp. **G. E. 25 cycle Motors.**
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2200—1100—220—110 volts.
Send us your inquiries.

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200-K.W., G. E. Rotary Converter

A.C. end 2300 volts, 60-cycle, two or three phase, D.C. end 125-250 volts, 3-wire, with switchboard and transformer.
The above is used apparatus in A-1 condition and guaranteed.

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Westinghouse

20	860	4
20	1160	6
25	1755	1
25	1160	2
25	860	9
30	1140	6
30	860	3
40	1755	1
40	1170	4
40	870	5
50	1170	3

We have a large stock of single-phase, two-phase and direct-current motors—also transformers. Let us send you our monthly stock list.

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1—75 kw. used Motor Generator Set. 230-volt, D.C. generator. 220-volt, 3-phase, 60-cycle motor 900-r.p.m., complete with switchboard $2500.

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3—500-hp., 175-lb., with stacks.
4—250 hp., 175-lb., with stacks.

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72 x 20 Flush Front, 135 lb.
150-hp. No brick setting required.

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1500 hp. 1000 hp. 400 hp.
1000 hp. 500 hp. 250 hp.

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18 x 42 Hamilton. 10 x 20 Hamilton

Direct Current, Direct Connected, 110 V.

1—500 kw. 2—300 kw. 1—100 kw.
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1—20 kw. 1—10 kw.
With Complete Storage Battery Plant

Direct Connected—220-275 Volts

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3—150 kw. 1—200 kw. 1—75 kw.

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3—37½-kva., single-phase, 60-cycle, 22,000 volts primary, 220 volts secondary.

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2—150-hp. Geary W. T. Boilers

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One slightly used 100-hp., 220-volt, 3-phase, 60-cycle, type CCL

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speed 1200 r.p.m., complete with extended sliding base, and out board, pedestal bearing, pulley 14 in. diameter, with 18-in. phase, sterling compensator.

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2—75 kw. 250 volt D.C. direct connected to Fleming Harrisburg Engines. each complet with switchboards and instruments.

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1—60-kw. 250-volt direct current, direct connected to **Chandler & Taylor Engine**, with board.

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1—80-kw. 250-volt **Direct Current Generator.**

1—13 x 18 Erie non-releasing Corliss Engine and belt for driving above engine.

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Every one of these motors is practically new, very little used and in the best of condition. Their condition and price make them exceptional offerings.

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Engine—Buckeye heavy duty, cross compound condensing, steam pressure 125 lb.

Generator — Westinghouse rotating armature type, 2-phase, 60-cycle, 2200 volts, 189 r.p.m.

Above unit complete with jet condenser and exciter.

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All motors guaranteed in perfect operating condition.

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Condition Excellent.

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470 R. P. M. 250 volts. Complete with sliding rails, pulley and field rheostat. Must move at once. Price $800 f. o. b. Cleveland.

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On all kinds and sizes A.C. or D.C. motors and generators, starters, welders, controllers, or anything electrical. Quick shipment from stock material, of coils commutators—shafts—bearings, etc. **Remember our initials stand for our product.**

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WASTE: Money! Time! Space! Labor! Material!

—the *money* such equipment or material cost earns nothing and is not available for other use.

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—the *space* it occupies costs money and may be needed for other purposes.

—the *labor* of its manufacture is wasted and also the labor of producing a duplicate for the man who can use it.

—the *material* it represents would be useful in another form.

Cut out *all* this waste! Don't have material or equipment around that is not needed. Turn it into cash.

There is always a market for scrap or good used machinery. Conservation of both materials and machinery can be practiced with just as much profit in peace as in war times.

Buyers for surplus material, good used machinery, junk or scrap can easily be found through the

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Queen-Gray Acme Portable

Galvanometer Testing Set

In perfect condition

PRICE $60.

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Electric Light Plant—For Sale

One 35 Kw. alternating current Western Electric generator, 3-phase, direct connected to one 12 x 10 VS7 Sturtevant upright engine with an exciter rated 5 Kw., 300 r.p.m., 125 volts.

Generator to deliver full rated load at 300 r.p.m. Full load everage 220 volts. Set to be used in 25% unbalanced compensator or 220/110 volts, three wire system.

70 pounds steam pressure, 5 inch back pressure.

Trumbull Electric Co. switch panel equipped with ammeter volt meter, two single light pilots, two ground detector receptacles, generator and exciter field rheostats, also circuit breaker and one three pole double thru switch.

To operate this plant as one, two or three phase system it is only necessary to change connections at the terminal board.

Plant shipped new from factory September, 1911. Not run since July, 1917. Is in good order and ready for immediate service.

Price subject to your own fair valuation.

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One 35- to 45-Kw., 60-cycle, 3-phase, 2300-volt belted

ALTERNATOR WITH EXCITER

JOS. L. SKELDON ENGR. CO.
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GENERATING UNIT

Nash two cylinder vertical gasoline or fuel Engine, direct connected to 12½ kw., D.C. Generator, almost new.

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PROMPT DELIVERY

VERTICAL ALTERNATORS AND EXCITER

2—650-kva., 150-r.p.m., 48-pole, 2400-volt, 156 amperes, 60-cycle, 3-phase, vertical type Generators, complete with bases, shafts, steady bearing sand field rheostats.

1—50-kw., 450-r.p.m., 125-volt, vertical type exciter, complete with base, shaft, thrust bearing above and steady bearing below, and field rheostat.

For details and very attractive prices, write us.

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BRAND NEW

ROTARY CONVERTER

60 kva. 60-cycle, 3-phase, 230-volts.
Very low price.

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Quality Machinery
Never causes failures or regrets
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2—12 x 12 x 10-in. **E. H. Flange Tee**, F. & D.
1—12-in. **E. H. Flange Tee**, F. & D.
3—12 x 12 x 8-in. **E. H. Flange Tee**, F. & D.
1—12 x 12 x 4-in. **E. H. Flange Tee**, F. & D.
5—12 x 12 x 6-in. **E. H. Flange Tee**, F. & D.
2— 8 x 8 x 8-in. **E. H. Flange Tee**, F. & D.
1—10 x 8 x 8-in. **E. H. Flange Tee**, F. & D.
1—4½ x 4½ x 4½-in. **E. H. Flange Tee**, F. & D.
1—12 x 12 x 7 x 7 **Cross**, F. & D.
1—12 x 12 x 4½ x 4½ **Cross**, F. & D.
1—10-in. **Ell E. H.**, F. & D.
1— 6-in. **Ell, E. H.**, F. & D.
1— 8-in. **Ell, E. H.**, F. & D., long sweep.
2— 8-in. **Ell, E. H.**, F. & D.
1— 7-in. **Ell, E. H.**, F. & D.
2—12-in., 45 deg. **Ell E. H.**, F. & D.
1—4 x 3 x 2½ **Tee, E. H.**, F. & D.
1—3 x 3 x 3 **Tee, E. H.**, F. & D.
1—7-in. **Ell**, with 2½-in. screw outlet.
2—8-in. **Facer**, 12¾ in. long, F. & D.
2—8-in. **Facer**, 12 in. long, F. & D.
1—10 x 8 x 8-in. **Tee, E. H.**, F. & D., 31½ in. long, face to face.
1—7-in. **Gate Valve**, Chapman Rising Stem.
2—4½-in. **Gate Valve**, Crane Rising Stem.
1—7 -in. **Gate Valve**, Non-rising Stem.
2—12-in. **Gate Valve**, Crane Rising Stem.
1—7 -in. **Gate Valve**, Crane Rising Stem.
1—6 -in. **Gate Valve**, Crane Rising Stem.
1—12-in. **Gate Valve**, with by-pass Crane.
1—12 x 12 x 7 **Tee E. H.**, F. & D. Crane.

Indiana Railways & Light Co.
Kokomo, Ind.

WANTED

Engine & Turbo Generator Units—D.C. & A.C.
(All Sizes; Any Voltage)
Boilers—H.R.T. & Water Tube.

FOR SALE

500—220/440 A.C., 3/25 **Cycle** (all sizes).
200—110/220 D.C. & A.C. (all sizes).
Engine & Turbo Generator Sets—A.C. & D.C. (all sizes).
Boilers—H.R.T. & Water Tube—all sizes.

Correspondence solicited.

JOHN A. STEWART ELECTRIC CO.
208 So. LaSalle St., Chicago, Ill.

A. C. GENERATING UNITS

200 KW. 2200-v., 3-ph., 60-cy., Westinghouse direct connected to 17½ and 21½ Buckeye engine with exciter and board.

160 K.V.A. 440-v., 60-cy., 3-ph., Crocker-Wheeler direct connected to 17 x 16 Straight Line engine with board.

500 Motors and Generators
all sizes and voltages, fully guaranteed.

GREAT SAVINGS IN PRICES

WICKES MACHINERY CO.
Jersey City, N. J.

FOR SALE

100-Hp., 2-Phase, 60-Cycle, 220-Volt

514-r.p.m. Burke Squirrel Cage

MOTOR

with extended shaft for third bearing. G-E Compensator Starter, no base rails, pulley or 3d bearing. New, never used. *Immediate delivery.*

The Philadelphia Rubber Works Co.
Akron, Ohio

MACHINERY

WANTED

MISCELLANEOUS

WANTED TO BUY

HORIZONTAL TURBO GENERATORS

2—500 KW. 1—750 KW. and 1—1000 or 1500 KW.

100 to 150 lb. steam pressure, 3-ph. 60-cy. either 2200 or 440 volt. Wire price including complete specifications together with list of switchboard and auxilaries.

W. C. McCREERY
63 Horton Street, Seattle, Washington

Turn Your Motors Into Cash

WANTED

Electric Motors
Electric Exhaust Fans

We are ready to purchase in any quantities Electric Motors $\frac{1}{4}$ to 100 H. P., A. C. and D. C. 110-220-550 Volt. Wall, Desk, Oscillating, Exhaust and Ceiling Fans.

LEATHER BELTING

Mail list with prices, if interested will mail check.

MONARCH ELECTRIC MOTOR CO.
166 Centre St., Cor. Canal St. New York City
Franklin: 1240, 6232, 6233

WANTED
One Direct Connected **Engine Drive Alternator Set** 1100-volts, 2-phase, 60-cycle, 100-Kw. to 200-Kw. capacity. Also One 250-volt direct current **Engine Set direct connected.**
HENRY P. THOMPSON
Mercantile Library Bldg., Cincinnati, Ohio

Wanted for Immediate Delivery

One Rotary Converter or Synchronous Motor Generator

with necessary transformers.

13,200 volts, 3 phase, 60 cycle, for 550-600 volt D. C.

Rockingham County Light and Power Co.
Portsmouth, N. H.

Engine Generator Units Wanted

Complete, either alternating or direct current.

Let me know what you have available as to capacity and voltage.

C. H. MOHR, 3817 Ashburton Ave., Baltimore, Md.

WANTED

MOTORS

One 100 H.P., 230-volt, 500 to 600 RPM, direct current, compound wound motor.

Also, one 40 to 50 H.P., 230-volt, 600 to 900 RPM motor.

THE JOS. L. SKELDON ENGR. CO.
Toledo, Ohio

WANTED

250-H.P.

Westinghouse Motor

3 Phase, 25 Cycle, 2200 Volt, 240 R.P.M., in first-class condition.

C. P. WILSON SO.
709 Lunsden Bldg., Toronto, Canada.

QUICK ACTION
SPOT CASH PAID
for
electric motors, machinery or entire plants.
Any amount.
NATHAN KLEIN & CO.
Howard & Centre Sts., New York City

Keep Your Eye on The "Searchlight"

and your advertisements in it

Get Your Wants into the Searchlight

ADVERTISING RATES

Ads Set in Uniform Style

(Solid, in one paragraph, without display.)

THREE CENTS A WORD, minimum charge 50 cents an insertion, payable in advance, less 10 per cent. if one payment is made in advance for four continuous insertions—for advertisements under:

Positions Wanted	Vacation Work Wanted
Evening Work Wanted	Salesman Wants Connections

FIVE CENTS A WORD, minimum char e $1.50 an insertion, for advertisement under:

Agencies Wanted	Positions Vacant
Agents Wanted	Partner Wanted
Business Opportunities	Representations Wanted
Desk Room for Rent	Salesmen Wanted
Educational	Patents for Sale
Employment Agencies	Plants for Sale
Desk Room Wanted	Sub-Contracts Wanted
Foreign Business	Work Wanted

Miscellaneous for Sale, for Rent or Want Ads.

THIRTY CENTS A LINE, minimum five lines, for all undisplayed advertisements set with a paragraph for each item or tabulated.

THREE DOLLARS AND SIXTY CENTS AN INCH for advertisements for bids (Official Proposals).

Ads Set i n Display Type

(Individual space, within border rules.)

Space for these advertisements is sold by the inch. Each page contains 30 inches. The rate per inch is based on the *total* number of inches to be used—that is, the number of inches the advertisement is to occupy multiplied by the number of insertions it is to receive. For instance, a 2-inch advertisement in 2 issues earns the 4-inch rate of $3.90 an inch. A 1-inch space for 4 issues, or a 4-inch space in one issue, also earn the 4-inch rate.

SCHEDULE OF RATES

1 to 3 in.,	$4.00 an in.	15 to 26 in.,	$3.70 an in.
4 to 7 in.,	3.90 an in.	27 to 49 in.,	3.60 an in.
8 to 14 in.,	3.80 an in.	50 to 99 in.,	3.50 an in.

Rates for larger space furnished on request.

For quick and satisfactory results tell the reader everything that he will want to know.

INFORMATION

ALLOW FIVE WORDS for the address, if replies are to a box number in care of any of our offices There is no extra charge for forwarding replies.

IN REPLYING TO ADS, do not enclose origin a testimonials or anything that you may want returned. State your experience and qualification in as concise and neat a manner as possible and enclose copies of your testimonials.

BE CAREFUL TO PUT ON ENVELOPE, when answering any "blind" ad, the box number in the ad., the name of the paper, and also the local address of office to which reply is sent:

36th St., at 10th Ave.,	New York
935 Real Estate Trust Bldg.,	Philadelphia
657 Lead er-News Bldg.,	Cleveland
1570 Old Colony Bldg.,	Chicago
501 Rialto Bldg.,	San Francisco

WHEN ADVERTISING MACHINERY, use your own name and address—or a local address of some kind—so that the readers can wire direct and get quick replies. We advise also that you state in your advertisement the present location of plant that is offered for sale, or point of delivery provided you are in the market for equipment.

TO SIGN YOUR NAME and address to your advertisement begets the confidence of the reader and facilitates receiving replies. You can, however, obviate delay in receiving answers by signing your ad. only with initials (your own or others), care of your home, your office or a post-office box number in your city.

FOR SALE

Magnet Wire, Volt Meter and Arc Lamps

Magnet wire, No. 18, No. 38 and No. 39; resistance wire, No. 38 and 39, 100 arc lamps, D.C., and volt meters and ammeters for sale at half price. Walsh's Sons & Co., Newark, N. J.

Motors—Sell Cheap

Two 20 HP. 25 cycle Westinghouse; four 10 and two 15 HP. 60 cylinder Robbins & Myers. All complete with starting compensators, pulleys and rails. H. W. Wiswell, 122 N. 7th St., St. Louis, Mo.

Vertical Motors For Sale

2 G. E., 50 hp., 1800 r.p.m., 440 volt, 60 cycle, 3 phase, vertical, Form K motors, each with no-voltage release starting compensator and overload relay. Practically new. Also large stock motors and generators. Write for stock list. V. M. Nussbaum & Co., Ft. Wayne, Ind.

Generators For Sale

Two C. & C. generators, type SL, 1.8 kw., 60 volts, 30 amps., 1750 r.p.m. Complete with rheostat pulley and base; one new, one used four weeks. Make offer. D. J. Carter, 6 Wilson St., Bridgeport, Conn.

Get your Wants into the Searchlight

MISCELLANEOUS

Electricians

Send $1.50 for 16 blue prints of Motor Windings, 10 A. C. Single, two and three-phase, and 6 D. O. or set of 20 A. C., 6 D. C. and 6 Rotary Converter Drawings for $2.25. Connecting and Winding made easy. Superior Electric Co., Lock Box, 1372, Pittsburgh, Pa.

PATENT ATTORNEYS

Patents, Trademarks, Copyrights—If you have an invention write for our Free Illustrated Guide Book, "How to Obtain a Patent." Send model or sketch and description for our free opinion of its patentable nature. Highest references. Prompt service. Reasonable terms.

VICTOR J. EVANS & CO.
845 Ninth St., N. W., Washington, D. C.

Business Opportunities

Capital—Partners—Plants—Shops—Properties—Industrial Sites

Combination Electric Light and Ice Plant

For sale in one of the healthiest sections of South Carolina; equipment in best of condition and urgent demand for all the ice we can produce. Can arrange terms and give possession at once. Come and see it in operation. Boyd Utilities Plant, Johnston, S. C.

Electrical Household Appliances

An organization capable of nationally distributing electrical household appliances is in a position to contract for the entire output of a plant now manufacturing or in a position to manufacture electric clothes washers or dish washers. Would consider aiding in the manufacture of any meritorious machine that is now partially developed. BO-989, Elec. World.

Electric Light and Ice Plant

For sale, in county seat town; liberal franchise; street lighting, city pumping, six smaller towns within radius of 15 miles. A real opportunity for party having a little capital. Address Box 232, Edina, Mo.

A Manufacturer of Electrical Appliances

Wishes to secure the services of a man capable of developing for the market an electric household clothes washer or dish washer. BO-990, Elec. World.

BUILDING

(Steel Frame)

132 ft. x 100 ft.—24 ft. to eaves. Roof consists of two trusses—50-ft. span each. Used as a power house and machine shop during construction of East River Tunnel.

In Excellent Condition
Plan of building can be furnished

BOOTH & FLINN, Ltd.
17 Battery Place, New York

POSITIONS VACANT

EMPLOYMENT

POSITIONS WANTED

OFFICIAL PROPOSALS

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C. June 2, 1919.—Sealed proposals will be opened in this office at 3 p. m., July 1, 1919, for supplying to the various Federal Buildings, Marine Hospitals, and Quarantine Stations under the control of the Treasury Department, portable desk lamps during the fiscal year ending June 30, 1920, in accordance with the drawing and specifications, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 19, 1919. Sealed proposals will be opened in this office at 3 p.m., July 16, 1919, for furnishing and installing lighting fixtures in the South Building, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C., in accordance with drawings and specifications, copies of which may be had at this office. Proposals are desired only from those qualified to produce work of the highest grade, both artistically and mechanically, and the right is reserved to refuse to send the drawings and specification to or to receive proposals from any one who, in the opinion of the Supervising Architect, is not so qualified. Jas. A. Wetmore, Acting Supervising Architect.

POSITIONS VACANT

A DIESEL engine electric station engineer wanted who can operate engines in parallel and handle the switchboard. Steady job. Address Atlantic Light & Power Co., Coeymans, N. Y.

AN established electrical manufacturing company wants electrical technical graduates with steel mill experience for sales work. Selling experience not necessary. P-718, Elec. World, Leader-News Bldg., Cleveland.

AAE IS EVERYWHERE!

AMERICAN ASSOCIATION OF ENGINEERS
ADVANCE-CO-OPERATE
JOIN NOW
A.A.E.
NATIONAL HEADQUARTERS 28 S. LA SALLE ST., CHICAGO, ILL.

WRITE FOR BLANKS TODAY!

NAME .....
STREET .....
CITY .....
STATE .....

POSITIONS VACANT

A MUNICIPAL electric light plant desires a chief engineer at their power plant. Generating equipment consisting of 1 750 kilowatt turbine condensing, 1 400 k.v.a. alternator driven by Cross compound engine, non-condensing and 1 200 k.v.a. alternator driven by single cylinder engine. Correspondence confidential. P-981, Elec. World.

ARMATURE winder wanted for Western Kentucky coal field; one with experience on Sullivan short-wall machine armatures preferred. P-3, Elec. World.

BUSINESS manager and secretary wanted to represent a live Contractors' Association with qualifications as an organizer. A man with electrical experience preferred. State references, salary expected and qualifications in first letter. Address Secretary, 41 East Jefferson Avenue, Detroit, Michigan.

DRAFTSMEN wanted for the Panama Canal—1 electrical draftsman experienced in underground power distribution and building illumination; $168 to $179 month; 2 hull draftsmen, $168 to $231 month; 1 draftsman capable of handling municipal engineering work, $189 month; must be thoroughly experienced in special lines above indicated; American citizens under 50 years of age, in good health. Free steamship transportation from New York or New Orleans, salary beginning date of sailing. Write Chief of Office, The Panama Canal, Washington, D. C.

ELECTRICAL draftsman wanted by a California public utility corporation. Should be experienced in power house and substation design. Chance of advancement for right man. State age, experience and salary. P-912, Elec. World, Rialto Bldg., San Francisco.

ENGINEER familiar with the design and application of fractional horse power motors, both A.C. and D.C. Opportunity to develop with a rapidly growing business. In replying, give experience. P-995, Elec. World, Phil.

ENGINEER experienced in the design of induction motors. Permanent position for man able to do independent work. Please state training and experience. P-996, Elec. World, Phil.

ENGINEER experienced in the design of transformers. Permanent position for man who can qualify. State age, training, experience and salary expected. P-998, Elec. World, Phila.

EXPERIENCED electrical draftsman wanted, one who has had some mechanical experience preferred; state experience and salary expected in first letter. Electric Machinery Company, Minneapolis, Minn.

EXPERIENCED electrical draftsmen wanted for designing of high tension substations and power plants. Draftsmen must be capable of preparing bills of material and cost estimates for station designs. State age, experience and salary desired. P-960, Elec. World, Chicago.

POSITIONS VACANT

EXPERIENCED designing engineers, competent to do original design work on direct current motors and generators of small and medium sizes. In replying, state education, experience and salary expected. P-997, Elec. World, Phila.

HIGH-GRADE, experienced, new business solicitor wanted; capable of figuring requirements of small power jobs. Good salary, permanent position and opportunity for advancement in operating department. Give experience, record, salary desired, married or unmarried. Address Box 313, Cedar Rapids, Iowa.

METER tester; outside tester on single and polyphase meters. Within 50 miles of Chicago. State age, experience and salary wanted. P-993, Elec. World, Chicago.

POSITION open as chief draftsman for man having had experience on electrical measuring and protective apparatus. Unusual opportunity for advancement for the right party. Address P-987, Elec. World.

TECHNICAL graduates in E. E. wanted, recent and prospective. A few men will be employed at attractive rates by manufacturer of motors and generators located in Middle West. Send your application promptly, stating previous record and when you desire to start work. P-961, Elec. World, Chicago.

STEADY job; foreman electrician, all around for motor repairs A. C. and D. C. Good pay to cracker-jack man. P-986, Elec. World.

METER tester and repairman wanted. Good salary for the right kind of a man. References required. State experience. Box 373, Evansville, Ind.

EMPLOYMENT AGENCIES

Employment Service

The undersigned provides a confidential service designed to locate openings through correspondence for men earning not less than $2,500 and up to $25,000; all lines. Not an employment agency, but a constructive, initiative service, covering individual negotiations. Established 1910. Complete privacy assured; present connections in no way jeopardized. Send name and address only for explanatory details. R. W. Bixby, 310 Lockwood Bldg., Buffalo, New York.

EMPLOYERS

Send us your inquiries for men of technical training and experience. We are obtaining employment for soldiers, sailors and marines released from the service.
Re-Employment Bureau of New York City for Soldiers, Sailors and Marines, 505 Pearl Street, north of Municipal Building, Professional Section. Worth 9250.

POSITIONS WANTED

AMERICAN electrical engineer, 12 years' experience, mainly designing industrial plant installations. Moderate salary. PW-917, Elec. World.

AM desirous of connecting with electrical manufacturer or lighting company; age, 27; technical graduate; seven years' practical experience in electrical manufacturing, testing and new development work. Would consider position as salesman or representative. Recently discharged officer U. S. Air Service. Salary expected, $160 to $200 per month. PW-927, Elec. World.

CHIEF electrician open for position; 12 years construction, operation, maintenance; armature and field winding; storage battery work; honorable discharge U. S. Army. PW-11, Elec. World, Chicago.

COMBUSTION engineer, technically trained, ten years' experience in the burning of anthracite and bituminous coals in large power plants. Qualified to experiment with new methods of burning coal. PW-991, Elec. World.

ELECTRICAL engineer, ten years' experience; induction motor design 5 to 5000 H.P.; will design lines of motors or take charge of department. PW-870, Elec. World.

ELECTRICAL engineer; just the man you want invites your correspondence; six years' shop, installation, construction, maintenance, planning; one year coal mine electrification. French, Spanish, Domestic or foreign service; now first lieutenant commanding engineer horse and motor transport, A. E. F. Free about July 1st. PW-733, Elec. World.

Your Advancement

is largely in your own hands—it is doubtful if any one else is worrying over it.

Better positions are constantly being secured through small advertisements in the "Positions Wanted" columns.

60 CENTS FOR 20 WORDS

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad. and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
657 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

POSITIONS WANTED

DRAFTSMAN desires permanent position; has I. C. S. training and 10 years' experience. PW-918, Elec. World.

ELECTRICAL ENGINEER technically trained university man, desires responsible engineering position. Has had six years' extensive and varied laboratory experience in the development and testing of small electrical apparatus, the design of electromagnetic windings and of circuits. Thoroughly familiar with telephone and telegraph engineering, central officer and equipment; possesses broad general knowledge of electrical engineering subjects, including radiotelegraphy. Location near New York preferred. Your correspondence is invited. PW-945, Elec. World.

ELECTRICAL and mechanical engineer, with executive ability, desires position as manager, electrical engineer or superintendent of light and power company; 14 years' experience, office, design, construction and operation, steam and electric plants, refrigeration, general supervision light and power properties. Technical graduate, married, age 34, honest, honorable, capable, best references. Salary, $2400. PW-951, Elec. World, Chicago.

ELECTRICAL engineer and superintendent, technical graduate, 7 years' experience, recently released from army, desires position as electrical engineer of industrial plant, or central station distribution engineer. Broad experience in design, construction and operation of substations and electrical equipment for mills and mines. Formerly electrical superintendent of plant employing over 100 electricians. Salary, $3000. PW-992, Elec. World, Phila.

ELECTRICAL engineer, just the man you want, invites your correspondence; six years shop, installation, construction, maintenance, planning; one year coal mine electrification; French, Spanish; domestic or foreign service; now first lieutenant commanding engineer horse and motor transport, A. E. F.; free about July 1. PW-999, Elec. World.

ELECTRICAL construction and maintenance man; ten years' experience A.C. and D.C., desires change. South American work preferred. Best reference furnished. PW-10, Elec. World.

ELECTRICAL construction superintendent open for position; twelve years' experience on power and substations; railroad electrifications; industrial installations including steel mills and chemical plants and underground cable systems. Age, 33 years. PW-965, Elec. World, Phil.

POSITIONS WANTED

ELECTRICAL and mechanical engineer open for engagement; extensive experience covering consulting, power plant design, steam and electric substations, high tension design, factory management, waterworks design; highest references. PW-966, Elec. World.

ELECTRICAL engineer, army officer, leaving service. Seven years' experience, testing, appraisal, engineering and purchasing. PW-970, Elec. World, Philadelphia.

ELECTRICAL engineer; technical graduate; seven years with the General Electric Company, laboratory, test, design, construction foreman. Power plant and substation design, installation and operation. Minimum salary, $200. PW-953, Elec. World, Leader-News Bldg., Cleveland.

ELECTRICIAN, 29 years old, with 15 years' experience, construction and repairs, both as workman and contractor-dealer, enlisted and honorably discharged; desires position with lighting company or as traveling salesman with supply house, preferably west. PW-943, Elec. World, Chicago.

ENGINEER wishes a change; small light plant or mill preferred; correspondence solicited. PW-969, Elec. World, Chicago.

EXECUTIVE position desired; 12 years' general central station experience—motors, wiring, arc lamp, trouble, drafting, collection, meter, office and sales departments; 2 years' assistant to manager; married; 31 years of age; located, but desire change; best of employers' references. PW-972, Elec. World.

EXPERIMENTAL and development engineer, technical graduate, with 15 years' experience, competent to direct such work including design and manufacture. Also five years sales and management. Specialties telegraph, telephone, fog signals, submarine cable and automobile lines. PW-905, Elec. World.

FIRE prevention engineer; electrical engineer, technical graduate; 28; available August 1st; several years' experience design, manufacture, and installation protective devices; thoroughly familiar with commercial phases protection business; desires position of responsibility and prospects. Minimum salary, $2500. At present with A. E. F. PW-979, Elec. World.

GRADUATE electrical engineer; thoroughly trained by one of the larger companies with five years' industrial experience and two years' field service as captain engineers U. S. A.; will soon be available for engagement. Detailed information of training and experience and highest references will be furnished upon request. PW-13, Elec. World.

GRADUATE electrical engineer, 29, seven years' experience in the sale, purchase, application and operation of power machinery, seeks position as electrical engineer in progressive manufactory. Foreign service will be considered. PW-12, Elec. World.

POSITIONS WANTED

MAJOR of engineers, U. S. Army, with valuable connections and knowledge of government procedure, now holding administrative position in War Department, desires similar position with going concern. Salary $600. PW-984, Elec. World, Philadelphia.

MANAGER'S assistant and purchasing agent, or general superintendent of construction of interior, underground and overhead installation of electrical holding and operating company or municipal properties; have electrical education and 13 years' experience; economical manager and business builder. Past President of Electrical Association. PW-4, Elec. World, Chicago.

MANAGER, 12 years' experience in central station service. Particularly successful in building up run-down property and maintaining friendly relations with public. Married; 36 years old; best of references. PW-994, Elec. World.

METER and test engineer, technical graduate, 32, married; now employed; desires change. New England states preferred. References. PW-913, Elec. World.

OFFICER, 18 months in research, air service, wishes position, New England preferred. Previous experience in electrical engineering, physics and manufacturing. PW-1, Elec. World.

OPERATING engineer; 15 years' experience steam, electric and internal combustion engine plants; University graduate; age, 34; ex-soldier. PW-971, Elec. World, Chicago.

OPERATING position, hydro-electric preferred. Technical training, 7 years' operating of stations and large substations all types. Age 30, married. Can speak Italian. Would work on new project. PW-944, Elec. World, Chicago.

POSITIONS WANTED

PATENT engineer; electrical engineer; technical graduate; 28; several years' experience analysis and digest scientific papers with view preparing patent forms and claims; specially capable in analysis telephonic and telegraphic circuits; available August 1st; now with A. E. F.; minimum salary, $2500. PW-978, Elec. World.

SALES manager or industrial power salesman; twelve years' central experience; seven years as industrial power salesman for large company; isolated plant analysis; good record; personality; technical graduate; age, 37; married; salary, $2400. PW-988, Elec. World.

SUPERINTENDENT of electric light and power plant, or waterworks, in medium-sized city, or chief electrician in an industrial plant; age, 35; 16 years' experience, practical and technically competent with both steam and hydro-electric plants, would consider taking charge of installing new plant and running same afterward; am desirous of a steady position; employed, but desire change; can furnish references as to character and ability, available on short notice; least salary to start, $1800. J. M. C., 1816 14th St., Superior, Wis.

TECHNICAL graduate (2-year course), wishes position with power company. Overseas service. Honorably discharged. Varied experience. Available within thirty days. PW-2, Elec. World.

TECHNICAL graduate (I. C. S.), seven years' practical experience along maintenance and operation of A.C. and D.C. apparatus, including two years G. E. test of E. R. equipment, and nine months' switchboard operation, seeks position along testing, maintenance, or operation, with manufacturing or operating company; A-1 reference; single; 28; nationality, Slovak; Western states preferred. Salary, $100. Address PW-7, Elec. World.

TURBINE engineer and switchboard operator desires change; long experience. PW-8, Elec. World, Phila.

POSITIONS WANTED

UNIVERSITY graduate in electrical engineering; 5 years' experience; 30; married; desires permanent position along line of electrical research, testing or experimental work. Location preferably Ohio or adjacent territory. Salary to start secondary to securing right connection. Details of experience and references furnished on request. PW-9, Elec. World, Leader-News Bldg., Cleveland.

EXTRA WORK WANTED

Special Investigations or computations
Civil or electrical interfering with your executive duties undertaken in spare time, by engineer of broad experience and excellent conections. EW-975, Elec. World.

EDUCATIONAL

ELECTRICAL ENGINEERING—Practical one-year trade course; also two-year electrical engineering course. Comprehensive training in mathematics, mechanics, applied electricity and drafting, including actual installation, operation, testing and repair of electrical machinery and testing of steam and gas engines. New buildings and equipment. Send for catalog. Detroit Institute of Technology, Detroit Mich.

BLISS ELECTRICAL SCHOOL, Washington, D. C., again open to civilians. Condensed Course in Electrical Engineering. Complete in one year. For men of character, ambition, limited time. Principles and application of electricity. Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work. Construction, installation, testing. Fireproof dormotories, dining hall, laboratories. 27th year opens October 1st. Catalog.

Selling Opportunities

Salesmen — Agents — Representatives

SALESMEN WANTED

Salesman of Ability and Experience Wanted
To handle line of high-grade flashlights and batteries; assistant sales manager; excellent position for the right man; experience and references required. AS-14, Elec. World.

SALESMAN AVAILABLE

Electrical and Mechanical Sales Engineer
Recently severed connections government work with manufacturer war material, desires connection, salary or commission manufacturer of high-class material. Eastern territory preferred. AS-973, Elec. World, Phil.

AGENTS WANTED

Manufacturers Agencies Wanted
Demand increasing rapidly. If you are interested in responsible, reliable and experienced representation on the Pacific Coast, write Room 812, Hobart Building, San Francisco, Calif.

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
657 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

AGENCIES AVAILABLE

Do You Want Representation in Manchuria?
Advertisers are invited to communicate with Messrs. Fukuaho Company, Dairen, Manchuria, who are interested in all kinds of machine tools, engineering requirements and railway materials. If not already represented in Manchuria Fukusho Company invite correspondence with this end in view. Advertisers are requested to forward catalogues, prices and terms offered.

Get your copy in early—

Owing to the holiday next week, the forms for the Searchlight Section of the

July 5th Issue

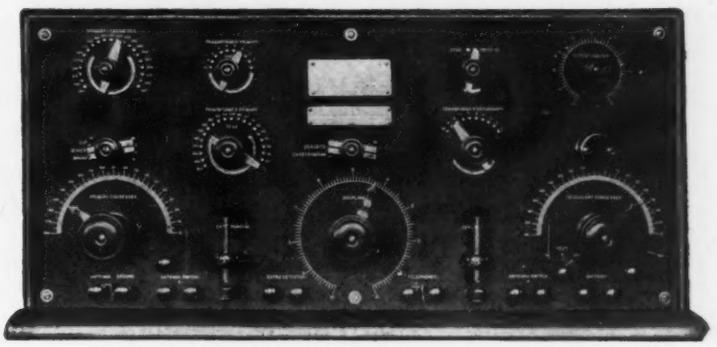
of

ELECTRICAL WORLD

will close for press at 10 A. M., Tuesday, July 1.

BAKELITE

REC. U. S. PAT. OFF.



From a bushing to a panelboard—

and for mechanical as well as electrical parts—the qualities peculiar to Bakelite make it the dependable and economical moulding material.

BAKELITE *combines* high heat resistance with great mechanical and dielectric strength.

BAKELITE is steam, oil, water and age-proof, chemically inert, odorless and tasteless.

BAKELITE will not shrink, swell, warp or split after being moulded.

BAKELITE takes a smooth, lustrous finish from the mould and needs no buffing to present an attractive appearance.

BAKELITE moulds to such an exact impression, no finishing hand work is necessary.

BAKELITE can be moulded with metal inserts incorporated in the process—thus eliminating a second operation.

BAKELITE would prove a decided manufacturing economy in half a hundred ways because of these half a dozen reasons. How about using

BAKELITE in your product?

The GENERAL BAKELITE COMPANY, 2 Rector Street, New York, welcomes inquiries from manufacturers and maintains a research laboratory for the working out of new applications.

2041-B

What Would You Think of a Manufacturer—

—who wrote to you with a lead pencil—"We are saving much money because we do not use typewriters and telephones"? You might as well wonder whether his merchandise was as much out of date as his business methods.

You kinow that modern time- and labor-saving appliances are not added expenses, but that they have superseded slower and more costly processes.

The concern which uses your business paper to tell you its business story is simply using a modern piece of selling machinery to make it easier for you to buy intelligently with the least waste of your time and theirs.

For the right kind of advertising shortens the distance between human minds just as certainly as the railroad shortens the distance between places. It is still possible to walk from New York to Chicago, and it is still possible for a business to get along without advertising, BUT—

—bear in mind that the seller who does not advertise does NOT save the cost of advertising, for it costs more to do the work of advertising by other means. Consistent advertisers are progressive merchandisers, and it pays to do business with them.

You are invited to consult us freely about Business Papers or Business Paper Advertising.

THE ASSOCIATED BUSINESS PAPERS INC.

The International Association of Trade and Technical Papers

Headquarters, 220 West 42nd Street, New York

LIST OF MEMBERS

Each has subscribed to and is maintaining the highest standards of practice in their editorial and advertising service.

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Rome-Wire

Rome Service Starts at the Wire Bar

FROM the time the wire bar goes into the billet furnace, every step in the progress of the wire to its finished state is under the observation and direct supervision of a capable expert whose duty it is to see that the Rome Standard is maintained.

Superior methods, special machines, close cooperation and rigid adherence to promises, make ROME SERVICE possible, and produce electrical wires and cables that are dependable in every detail.

NOW is a good time to test our assertion that the Rome trade-mark is a sign of efficient conductors.

Rome
Wire Company
Rome, N. Y.

All Operations from Wire Bar to Finished Product in this Plant.

Rome-Wire

Another New D & W Feature The Expulsion Link

is the greatest advance in RENEWABLE FUSE design yet produced.

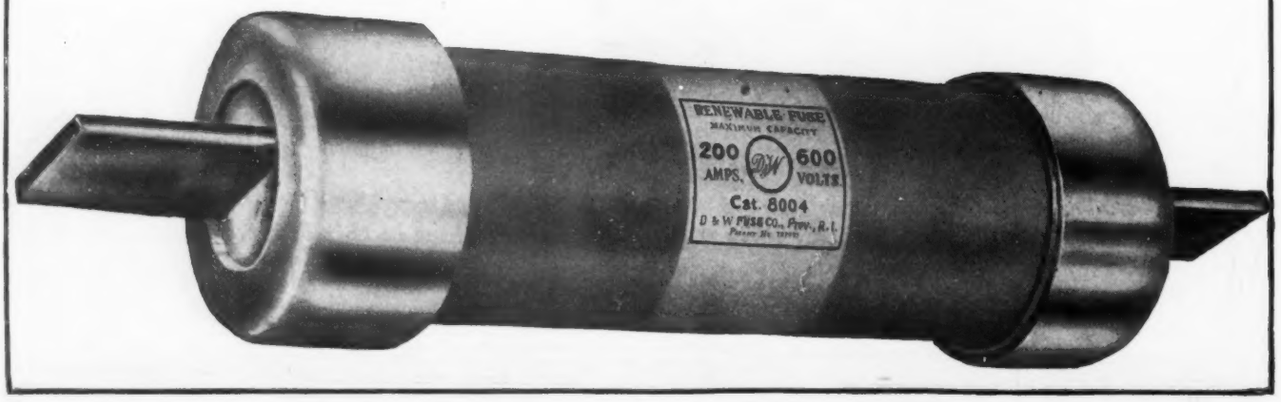
The new "JACKETED EXPULSION LINK" for knife blade type D. & W. fuses not only adds to the life of the shell but positively quenches the arc inside the "jacket" and the gases generated forcibly expel the fused metal at each end.

This disrupts the arc, prevents charring of tube and insures quick opening of the circuit. The threaded sleeves on the shell ends insure long life. The few parts make for simplicity—prevent cross threading and destroying of the threads as with threaded fibre which may also shrink or warp.

All steel parts of D. & W. RENEWABLE FUSES are oxidized, preventing adhesion of molten metal and insuring greater and more positive contact and carrying capacity.

Send for bulletins on "EXPULSION LINKS" and keep abreast of the times.

D & W Fuse Company
Providence R.I.
U.S.A.



THE output of Hoovers is the largest in the world. We are increasing it daily. Our 1920 plans embrace double the number of Hoovers which the most diligent efforts will produce this year. Popularity sets a fast pace—but we are constantly "covering more ground" with buildings to provide the necessary capacity to keep up.

The Hoover Suction Sweeper Co.

World's oldest, largest and most successful electric cleaner makers

North Canton, Ohio Hamilton Ont., Canada

The HOOVER
ELECTRIC SUCTION SWEEPER

It *Beats*...as it Sweeps as it Cleans

The

Edison

Nickel-Iron Alkaline

Storage Battery

The Standard Battery for work requiring strength, reliability and long life.

The Edison is the only Storage Battery having *any iron* or *steel* in its construction or elements, or having an *alkaline* (non-acid) electrolyte.

The Edison is built of steel, has the strength of steel. Remember that the alkaline electrolyte is a *preservative* of the iron and steel members. Then you see why repairs and replacements are a negligible factor in Edison Batteries.

EDISON BATTERIES ARE USED IN

Electric Vehicles
Ignition and Lighting
Industrial Trucks
Industrial Tractors
Mine Locomotives
Mine Lamps
Train Lighting
Railway Signaling
Wireless Operation
House Lighting
Submarines
Storage Battery Cars
Time Clocks, etc., etc.

Let us know your requirements or the battery service you are interested in.

Edison Storage Battery Co.

ORANGE, N. J.

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New York Boston Chicago Detroit
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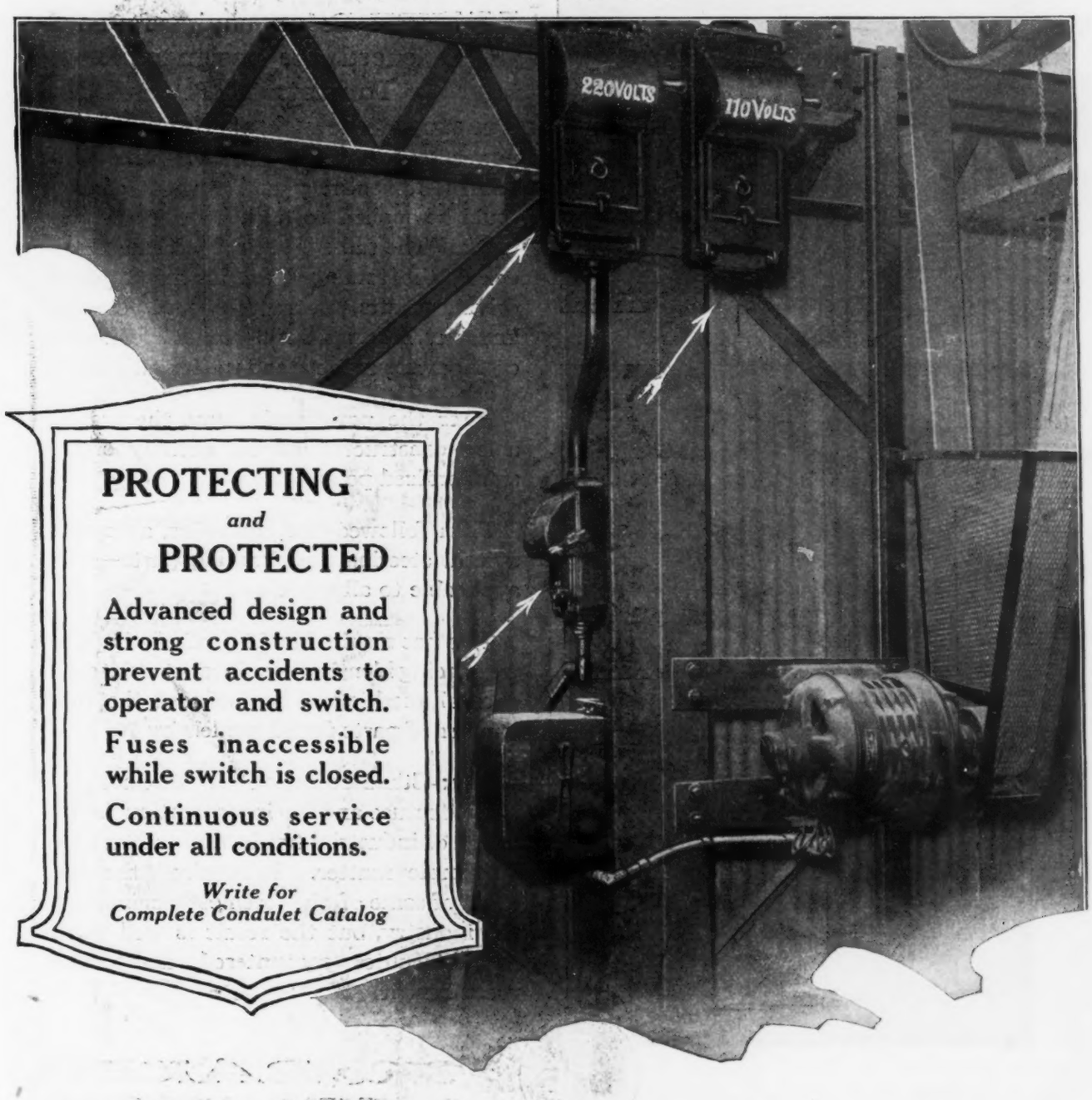
SAFETY LINE-SWITCH CONDULETS



PROTECTING
and
PROTECTED

Advanced design and strong construction prevent accidents to operator and switch.

Fuses inaccessible while switch is closed.

Continuous service under all conditions.

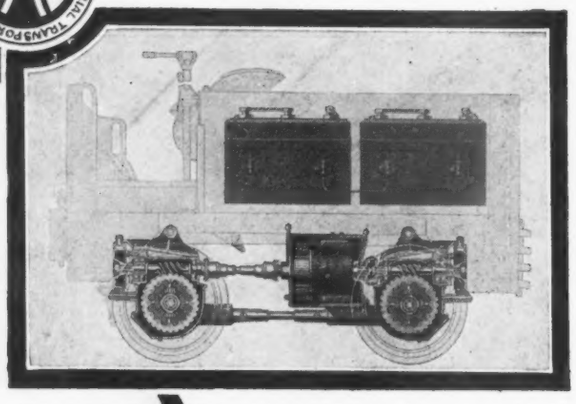
Write for Complete Condulet Catalog

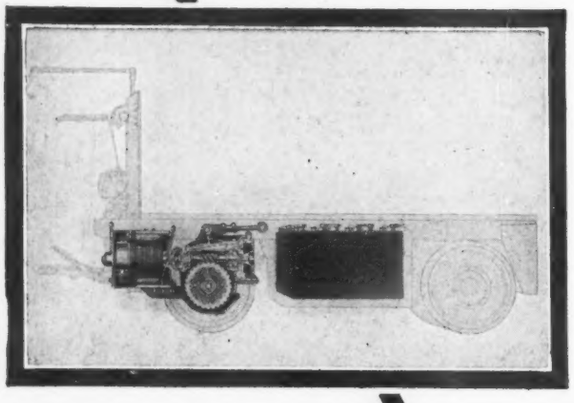
CROUSE-HINDS COMPANY
SYRACUSE, N.Y., U.S.A.

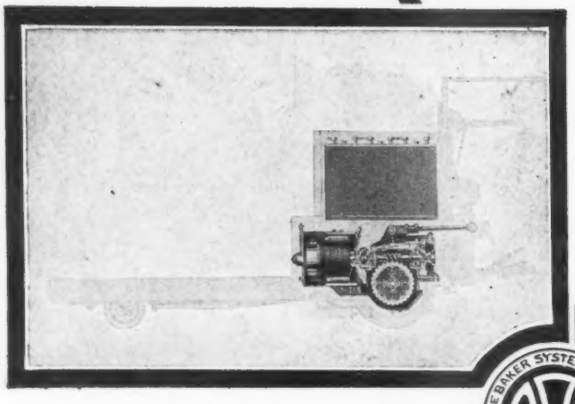
NEW YORK BOSTON CHICAGO

INTER-STANDARDIZATION

WHAT IT IS







WHEN Baker engineers commenced the design of Baker Electric Industrial Trucks and Tractors they first developed a power axle—a rugged, complete unit that in its entirety and without changes could be applied to any model or type of truck. The same wheels, the same differential, the same motor, universal joints, driving shafts, worm and gear, steering knuckles, bearings, springs, and axle housing casting were made standard for all models.

After the power axle came the trailing axle—constructed almost entirely of the standardized power axle parts.

Then followed the controller, automatic switch, steering and braking parts—each applicable to all models.

This has resulted in 98% of all the vital parts being identical—or inter-standardized—on all models and has reduced the total number of parts for all models by 70%.

Inter-Standardization is distinctly a Baker feature and its incorporation in the design of industrial trucks and tractors was no simple matter. It required the best effort of some of the foremost engineers in the industry, but the result is well worth the difficulties encountered and Baker users benefit.

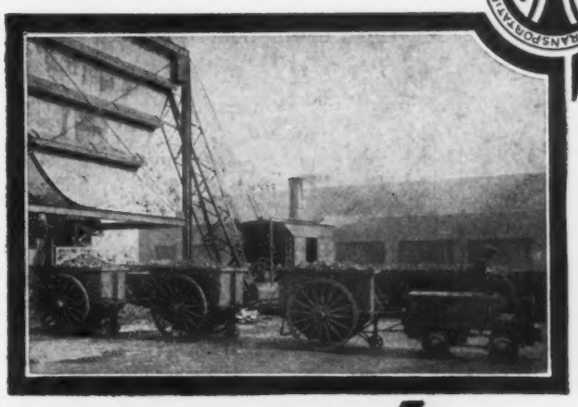
The BAKER
CLEVELAND, OHIO

The BAKER of INDUSTRIAL

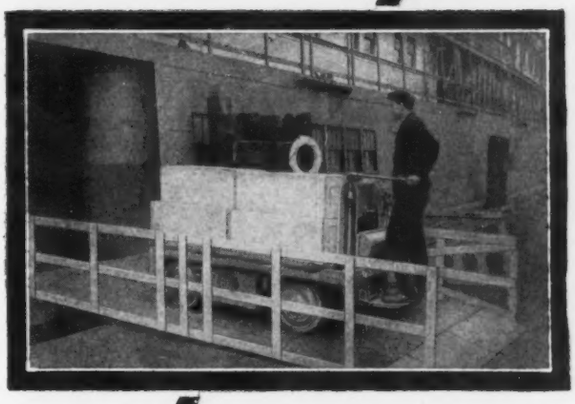
INTER-STANDARDIZATION

WHAT IT MEANS TO YOU

BAKER Industrial Trucks and Tractors are of more rugged construction. They are built of higher grade and better machined parts than any other make. But the 70% reduction in the number of parts manufactured cuts down costs and Baker Trucks and Tractors sell for no more than others.



Operators of fleets of Baker Trucks find them easy to maintain. All parts are accessible and alike on all models. The maintenance crew find their work greatly simplified and a reserve part for one model will fit all other models. In emergencies complete units may be transferred from one truck to another.

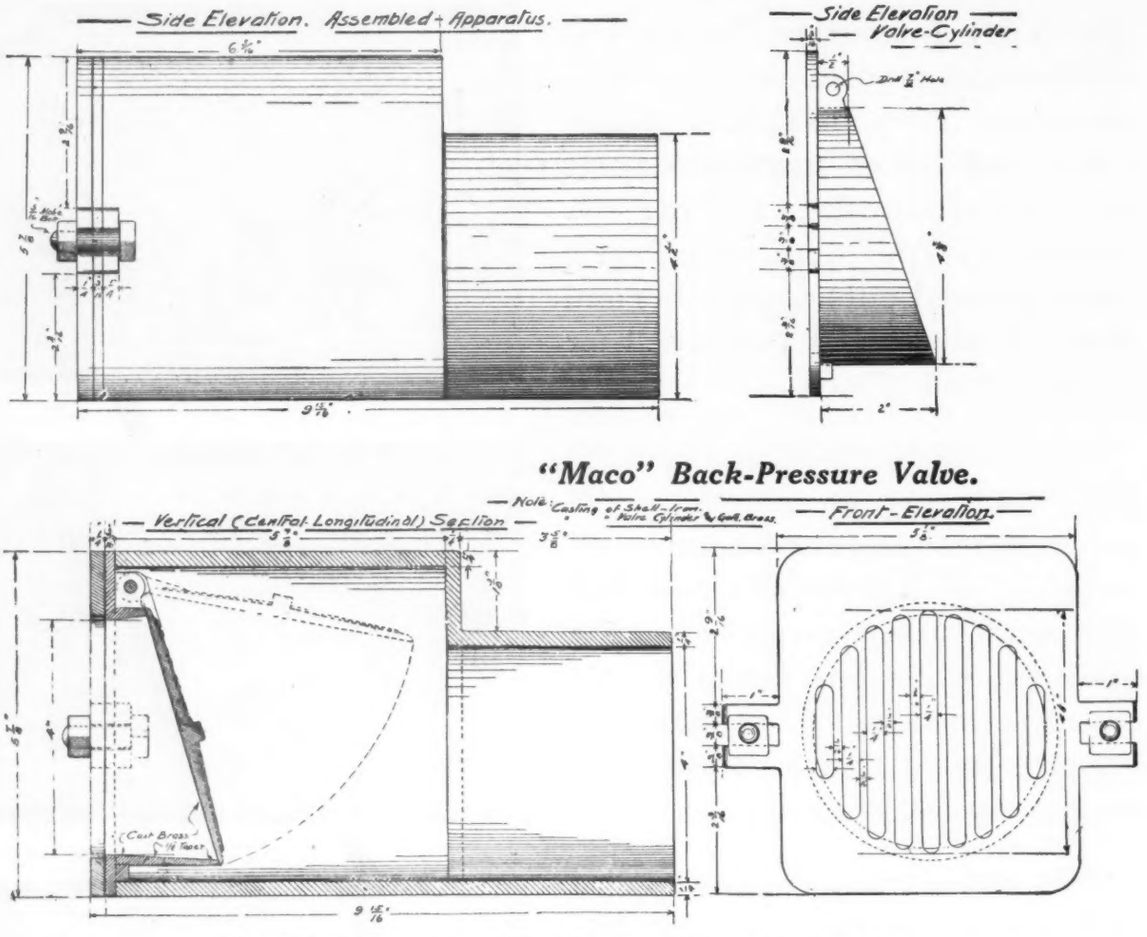


This idea—conceived and applied by Baker engineers—has contributed to the success of Baker Trucks and Tractors. It has made possible the marketing of a better truck at a reasonable price and has reduced maintenance costs and troubles to a minimum.

R & L COMPANY
ORIGINATORS OF

SYSTEM TRANSPORTATION

Keep Your



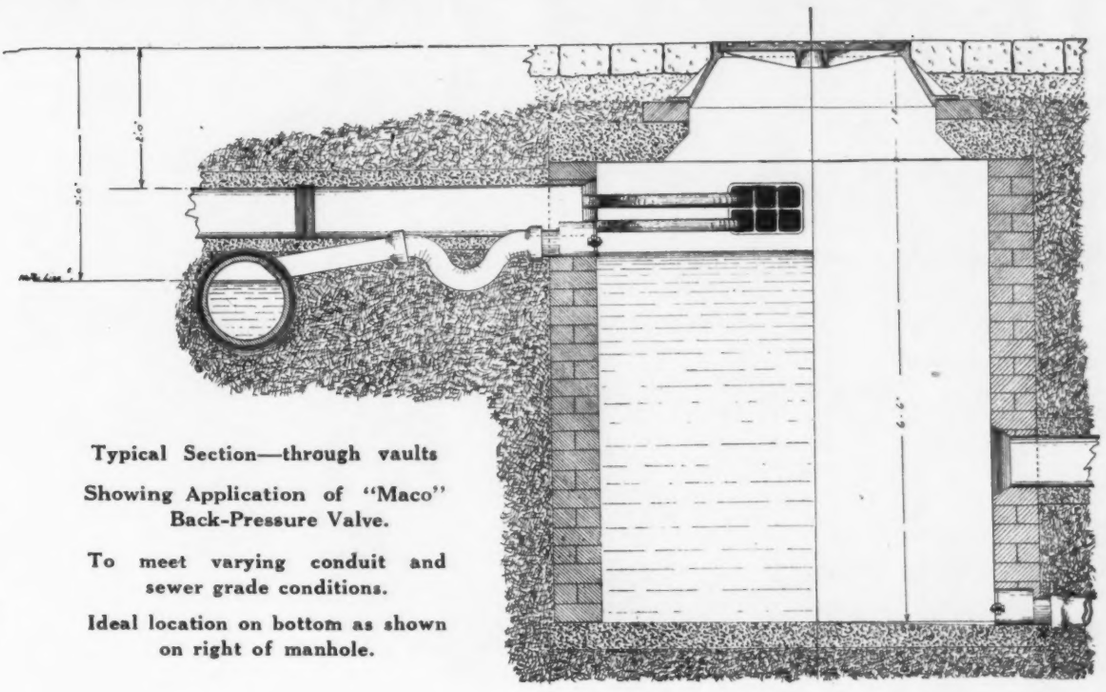
Detail Drawing of "Maco" Back-Pressure Valve with dimensions.

THE "Maco" Back-Pressure Valve will positively keep your manholes free from water and dirt to the height it is placed in the wall.

The depth of sewer regulates the height in wall the valve must be installed. Place as near the floor of manhole as possible.

W. F. CUMMINGS, INC.,

Manholes Dry



Typical Section—through vaults

Showing Application of "Maco" Back-Pressure Valve.

To meet varying conduit and sewer grade conditions.

Ideal location on bottom as shown on right of manhole.

The "Maco" Back-Pressure Valve will positively prevent sewer water backing up into manholes and flooding your conduit system.

The valve gate is readily removable should the sewer tile become clogged.

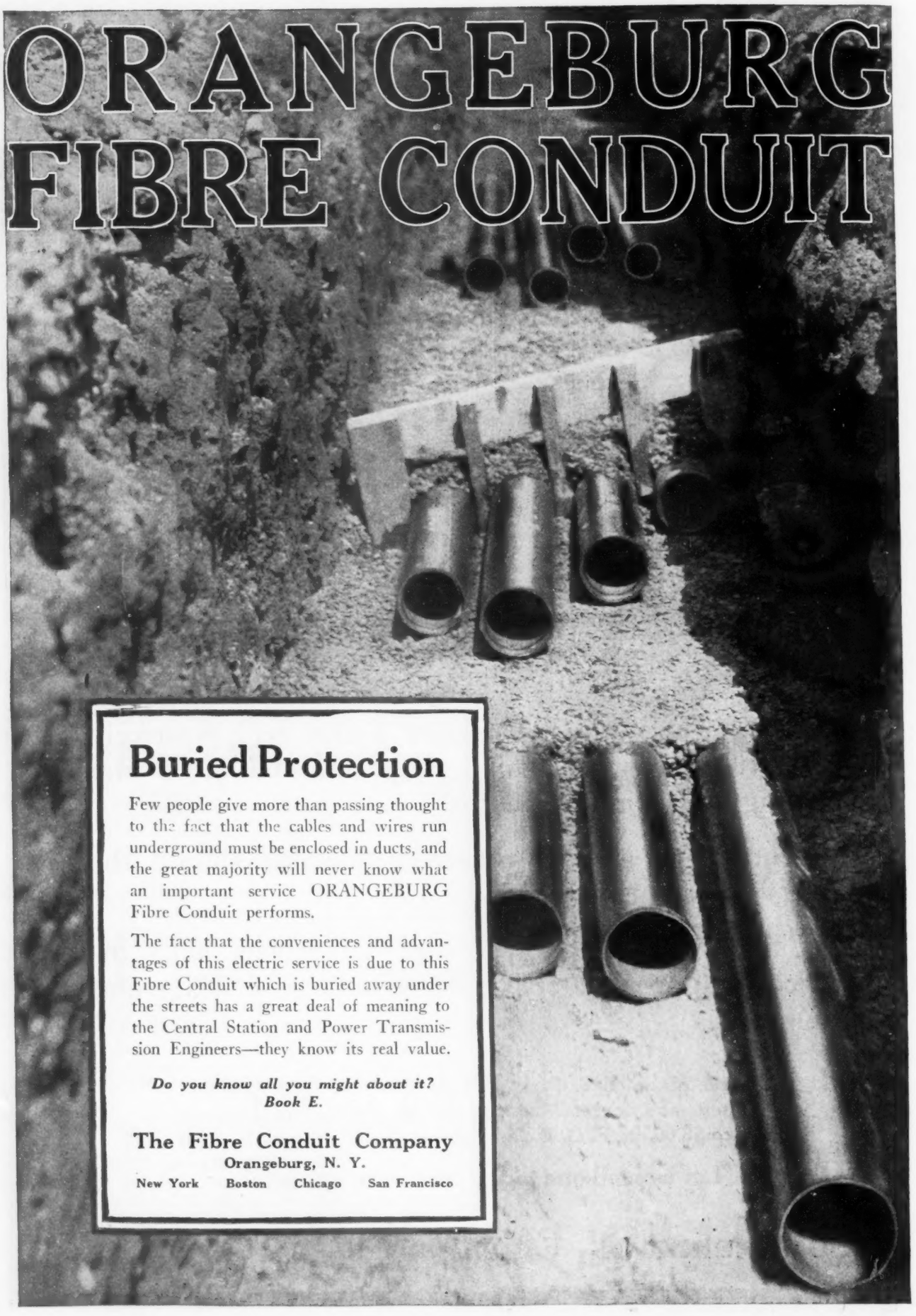
The "Maco" Back-Pressure Valve has been installed in approximately 1500 manholes in Chicago and elsewhere.

Place "Maco" Back-Pressure Valves in your Underground System and forget Mud and Water and Leaky Cables. Price $6.00 net F. O. B. Chicago.

Let us send one today subject to approval.

330 So. Paulina St., Chicago, Ill.

ORANGEBURG FIBRE CONDUIT



Buried Protection

Few people give more than passing thought to the fact that the cables and wires run underground must be enclosed in ducts, and the great majority will never know what an important service ORANGEBURG Fibre Conduit performs.

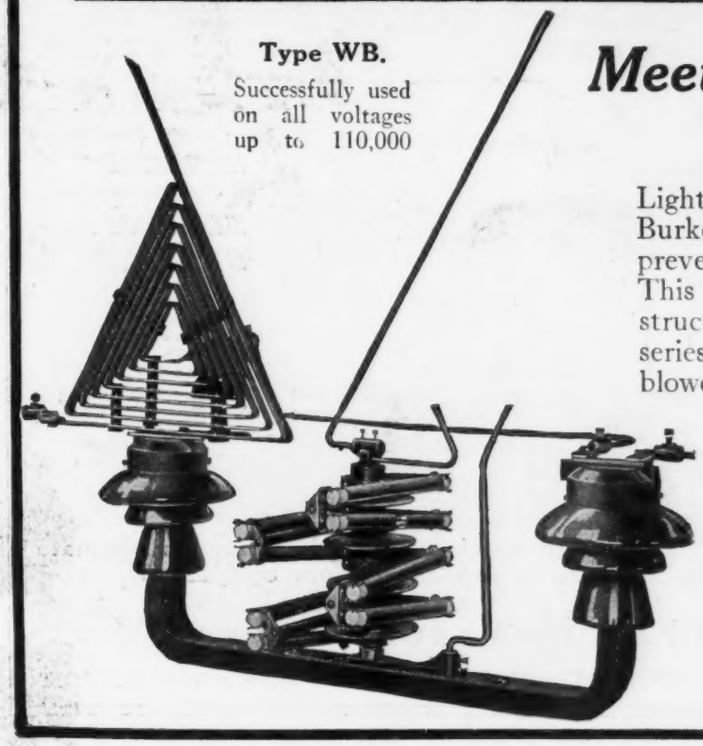
The fact that the conveniences and advantages of this electric service is due to this Fibre Conduit which is buried away under the streets has a great deal of meaning to the Central Station and Power Transmission Engineers—they know its real value.

Do you know all you might about it? Book E.

The Fibre Conduit Company
Orangeburg, N. Y.
New York Boston Chicago San Francisco

The BURKE ARRESTER

THE HORN GAP ARRESTER WITH THE TRIANGULAR CHOKE COIL



Type WB.
Successfully used on all voltages up to 110,000

Meets Most Exacting Needs

Lightning seeks a path to ground. The Burke Arrester provides a direct path and prevents surges passing the discharge gap. This is due to the triangular choke coil construction with its sharp turns, its sensitive series horn gap, its quick-acting magnetic blowout and its straight line discharge path.

Write for Bulletin.

Type WB, as well as WBR (for larger transmission systems) are pictured and described in an interesting bulletin, sent on request.

Railway and Industrial Engineering Company

Sales Office **Pittsburgh** ***Plant*** **Greensburg, Pa.**

Announcing

A New Emergency Power Plant

MEDIUM and high speed Sterling gasoline engines (which have held world's marine records for eight years) have been adapted for driving centrifugal pumps and electric generators. They are being used by many prominent pump manufacturers, coupled to Underwriters' fire pumps, and are installed in townships, villages, municipalities, department stores and manufacturing plants for fire protection. They are also utilized for emergency generator drives. The motors are admirable for either pump or generator operation, as they develop rated power at 800, 1000, 1200 and 1400 R.P.M. The construction is in 4, 6 and 8-cylinder units, 10 to 300 H.P.

Numerous units are employed in the United States and Canada. They are equipped for instantaneous starting for any emergency and will always furnish dependable power until the emergency will have passed.

Catalog on Request

STERLING ENGINE CO. *Dept. C-2* **BUFFALO, N.Y.**

SOME OF OUR MANUFACTURED PRODUCTS

ANNUNCIATORS
House
Hotel
Hospital
Elevator
Marine
Wood or Metal
All Styles of
Drops and Resets

BELLS
Iron Box
Wood Box
Fire-Alarm
Skeleton
Vibrating
Single Stroke
Weatherproof
Electro-Mechanical

BUZZERS
Iron Box
Wood Box

PUSHES
Wood
Metal
Desk
Door
Pear
Floor
Marine
Multiple
Table Clamp
All Finishes

OSTRANDER

Electrical Supplies and Specialties

Sockets

QUALITY PLUS SAFETY
KEY
KEYLESS
PULL CHAIN

Highly Systematized Manufacture.
Specialization of designers for the various articles we market, discriminating selection of materials and years of manufacture, enable us to keep OSTRANDER PRODUCTS supreme in their field, invincible in SERVICE.

SOCKETS
Key
Keyless
Pull Chain
All Finishes

FIRE ALARMS
Cabinets
Boxes
Systems for Current or Storage Battery

SHADES
Metal Shades of All Descriptions

LETTER BOXES
of All Descriptions

FLOOR BOXES

SPEAKING TUBE
Tin Tube
Flexible Tube
Whistles
Elbows
Collars
Roses

BURGLAR ALARMS
Door Springs
Window Springs
Transom Springs

TANK ALARMS

THE OSTRANDER PRODUCTION is on a firm, smooth running basis which assures adequate supply for the big demands which are sure to be made for our equipment.

371 Broadway, New York

BROOKLYN PHILADELPHIA CHICAGO BALTIMORE SAN FRANCISCO ST. LOUIS DETROIT

TRADE CHIEF MARK OSHKOSH

Play Safe with Your Construction Tools

For forty years, contractors and public service corporations have regarded the OSHKOSH brand on a construction tool as the same guarantee as "Sterling" on silver. America's big concerns, as a rule, will use no others. There must be a reason for this and the tools themselves in the hands of your workmen will show you what that reason is.

An Oshkosh-Equipped Crew Earns More

From a peavey to a huge concrete-road builder, the OSHKOSH line will furnish you with equipment that will show results in dollars and cents in your profits or dividends. An OSHKOSH catalog kept handy is a big help. And there's an OSHKOSH supply house near you, ready to give you service that will surprise you.

Write for that catalog TODAY.

Oshkosh Manufacturing Company

336 Wood Street, Oshkosh, Wis.

Oshkosh Construction Tools are carried in stock by all leading jobbers including—

Western Electric Company, Chicago, Ill., and All Branches.
Dillon Supply Company, Raleigh, N. C.
Kellogg Switchboard & Supply Co., Adams & Aberdeen Streets, Chicago, Ill.
Richards & Conover Hardware Co., Kansas City, Mo.

They Want More

The manufacturing activities of peace promise to outstrip those of war.

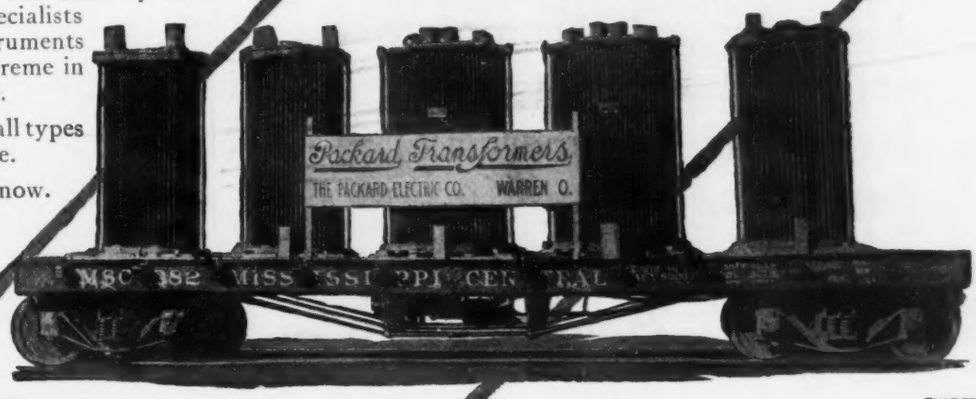
Packard Transformers, proved by their dependability and economy of operation, will help you to get your share of the world's patronage.

Designed and built by transformer specialists these instruments stand supreme in their field.

We build all types —any size.

Write us now.

Packard
Transformers



The Packard Electric Company
WARREN, OHIO, U. S. A.

We build transformers for any purpose. Tell us what you want your transformer to do and let us submit data and price.

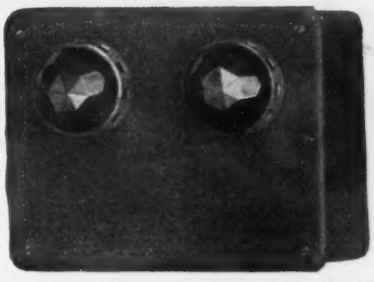
District Offices:
Cleveland, O. Chicago, Ill.
Denver, Colo. Detroit, Mich.
Los Angeles, Calif. Minneapolis, Minn.
Pittsburgh, Pa.

High Tension
LEWIS AND ROTH CORPORATION

For Modern Switching Structures

By unfailing indications (green and red) the operator can determine whether disconnecting switches are open or closed.

Instead of using red and green lamps



—with possibility of getting wrong color in a socket—clear lamps are used behind permanent colored lenses.

This is modern practice.

District Agents

Brett & Company, Union Central Building, Cincinnati, Ohio. Paul W. Koch & Co., Chicago, Ill. W. E. Reed Company, 18 Columbia Street, West, Detroit, Michigan. J. W. Fraser & Company, Commercial Bank Bldg., Charlotte, N. C. W. A. McCombs & Company, Union Arcade Bldg., Pittsburgh, Pa. Charles Farnham, I. W. Hellman Building, Los Angeles, Calif. Ferranti Electric Company, Ltd., Winnipeg, Toronto, Montreal, Halifax. Foster-McDonald Co., 85 High St., Boston, Mass. McCrum & Gillem, 1011 Empire Bldg., Birmingham, Ala. E. J. Putzell, 314 Hennen Bldg., New Orleans, La. E. O. Griffin Supply Co., 303 Carter Bldg., Houston, Texas.

LEWIS & ROTH CORPORATION HIGH TENSION PHILADELPHIA

PHILADELPHIA

LEWIS & ROTH CORPORATION HIGH TENSION PHILADELPHIA

Fir Cross Arms and Locust Pins

In Stock for Prompt Shipment

Also a large and complete line of Malleable and Steel Brackets, Pole Line Hardware, Street and Commercial Lighting Fixtures, Tape, Etc.

Ask for Prices

Philadelphia Electrical & Manufacturing Co.
1228-36 North 31st Street, Philadelphia, Pa.

Reserve Space Now!

For the Chicago

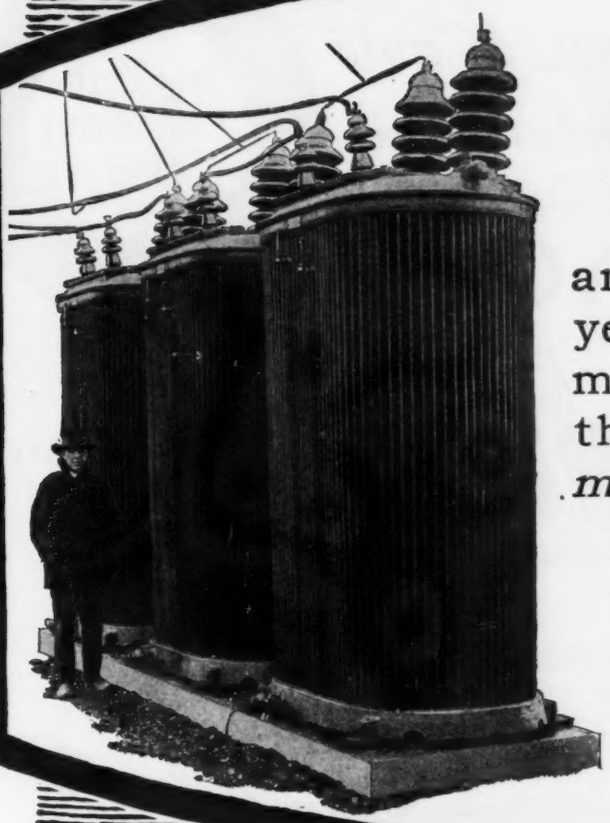
Electrical Trades Exposition

Coliseum, Chicago, October 11-25, 1919

THE FIRST CHICAGO ELECTRICAL SHOW SINCE 1911.
A LARGE AMOUNT OF SPACE ALREADY CONTRACTED FOR
MANY DESIRABLE SPACES MAY STILL BE HAD

DIAGRAMS OF SPACE CONTRACT FORMS ALL PARTICULARS
MAY BE OBTAINED FROM

ELECTRICAL TRADES EXPOSITION COMPANY
E. W. LLOYD, Manager
72 West Adams Street, Chicago, Illinois



MOLONEY TRANSFORMERS

are the product of many years' experience, development and service—we know they are *good, because many users* are *satisfied.*

MOLONEY ELECTRIC CO.

St. Louis, Mo. Windsor, Can.

OFFICES:

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Washington
Chicago
Minneapolis
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HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

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Baltimore, Md.	*Continental Trust Building*
PITTSBURGH, PA.	*Frick Building*
Buffalo, N. Y.	*Marine National Bank*
Cincinnati, Ohio	*Union Trust Building*
Atlanta, Ga.	*Candler Building*
Cleveland, Ohio	*Guardian Building*
Detroit, Mich.	*Beecher Ave. & M. C. R. R.*
CHICAGO, ILL.	*208 South La Salle Street*
St. Louis, Mo.	*Third National Bank Building*
Denver, Colo.	*First National Bank Building*
Salt Lake City, Utah	*Walker Bank Building*
Duluth, Minn.	*Wolvin Building*
Minneapolis, Minn.	*7th Ave. & 2nd St., S. E.*

Pacific Coast Representative:
U. S. Steel Products Co., Pacific Coast Dept.

San Francisco, Cal.	*Rialto Building*
Portland, Ore.	*Selling Building*
Seattle, Wash.	*4th Ave. So., Cor. Conn. St.*

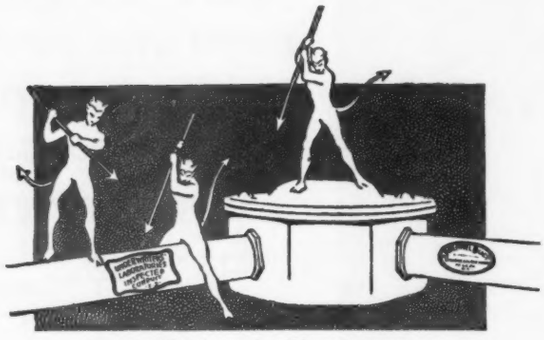
Export Representative: United States Steel Products Co., 30 Church St., N. Y.

Steel Armored Cable

Flexible - Conduit - Rigid

SPRAGUE

A Complete Line of Stamped Steel Boxes, Covers and Fittings



Interchangeable with Boxes and Covers of other manufacture

Resists the Elements

SPRAGUE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

Main Offices: 527-531 West 34th Street, New York City

BRANCH OFFICES IN PRINCIPAL CITIES

TRADE MARK

Hazard

RUBBER INSULATED

WIRES & CABLES

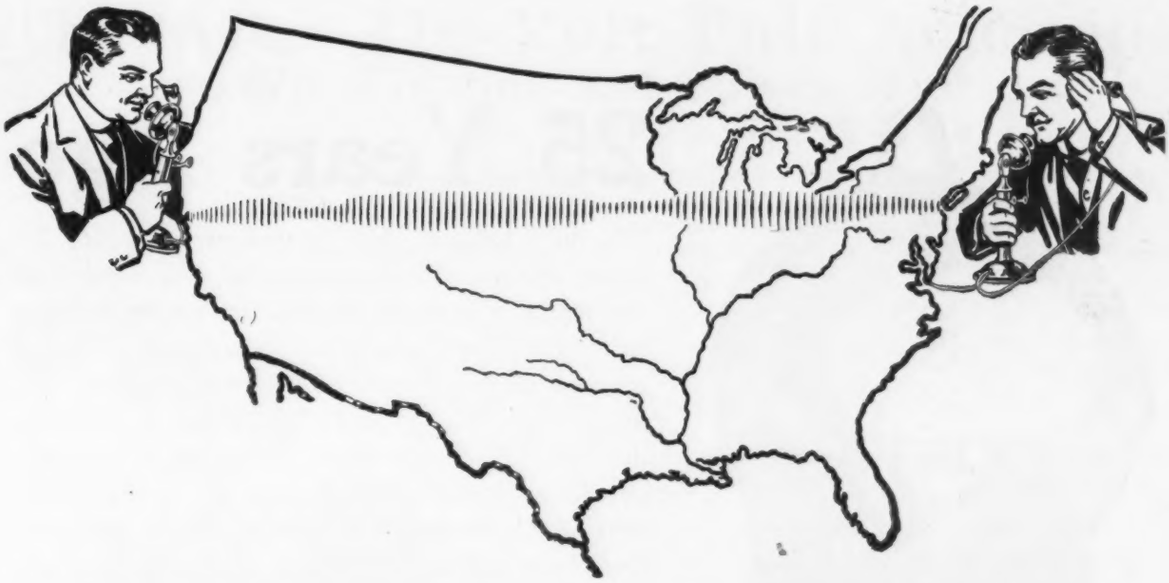
Represent the Square Deal between maker and user They stand for safety and economy in the transmission of electric current under practically all conditions of service.

Submarine Cables—Steel Taped Cables
Power Cables—Underground Cables
Circular Loom Cables—Code Wire

HAZARD MFG CO WILKES-BARRE PA

NEW YORK 533 CANAL ST PITTSBURGH 1ST NAT'L BANK BLDG CHICAGO 552 W ADAMS ST

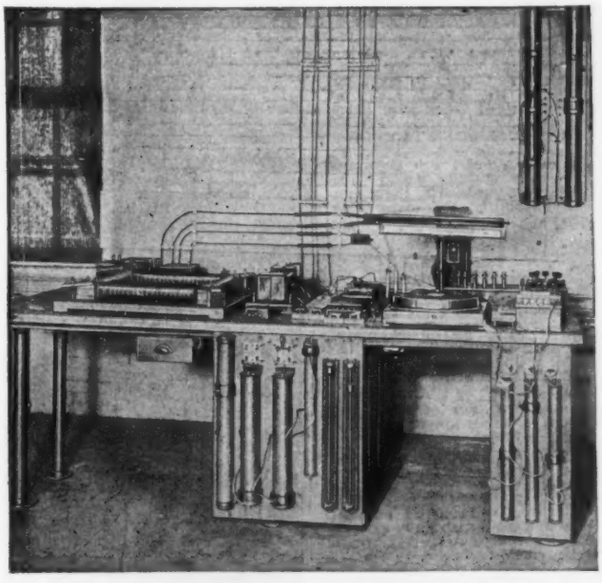
MAKERS OF QUALITY WIRE ROPE SINCE 1848



It takes only one-fifteenth of a second for the electrical impulse which reproduces the voice to span the continent from New York to San Francisco, 3400 miles, over the transcontinental line of the Bell System. Communication between important points over the long distance lines of the Bell System is practically instantaneous.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

MAGNETIC TESTS
OF IRON AND STEEL



Magnetic Testing Equipment

The iron and steel entering into the manufacture of electrical apparatus must contain certain properties and characteristics which must be definitely known.

The E. T. L. is completely equipped to make test for Hysteresis, Permeability, Energy Loss, or any special tests for manufacturers or others not having facilities for such work and who require an accurate, certified report on their products which will be accepted by experts without further question.

Electrical Testing Laboratories
80th Street and East End Avenue, New York City

Model M2

25 Years Ago

The first Duncan A.C. watt-hour meter of 25 years ago was heralded by the central station fraternity as a much needed device on account of its accuracy and dependability, and the users of that time yet give substantial proof of its merits by having thousands of them in use unto this day. Each new type of Duncan meter that has been brought out during the intervening years has been a masterpiece in the art, and now the Model M2 is conceded to be the acme of all that is worth while among present day meters.

DUNCAN ELECTRIC MFG. CO., LAFAYETTE, IND.

Portable Lamp and Scale Galvanometer

A suspension type d'Arsonval Galvanometer with Lamp and Scale—all in a single unit. About twenty times as sensitive as the best portable pointer instrument. Rugged as the ordinary voltmeter. We use it in many of the "working set-ups" in our own laboratory, and find it extremely popular there.

Bulletin 242 describes it—
let us send it to you.

LEEDS & NORTHRUP COMPANY
Electrical Measuring Instruments
4903 Stenton Ave., Philadelphia, Pa.

Steel Poles

For Every Pole Purpose

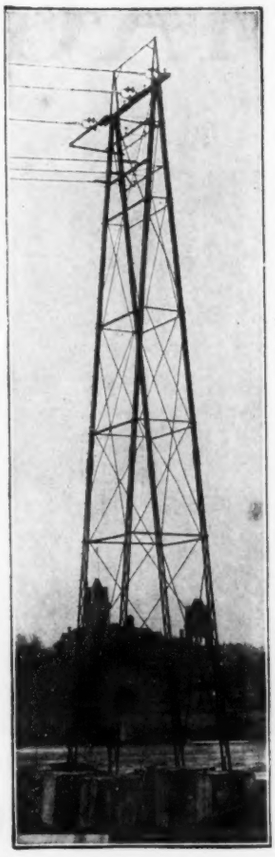
Cut shows Bates Steel Towers in use by Consolidated Water Power & Paper Co., Grand Rapids, Wis. This structure is 70 ft. high and acts as dead end for six heavy conductors on 1000 ft. span. It evidences the broad range of adaptability of Bates Steel Poles. Our slogan "STEEL POLES FOR EVERY POLE PURPOSE" is most fitting and appropriate. Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose.

Telegraph
Telephone
Power Transmission
Electric Trolley Lines
Electric Lighting, Etc.

Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

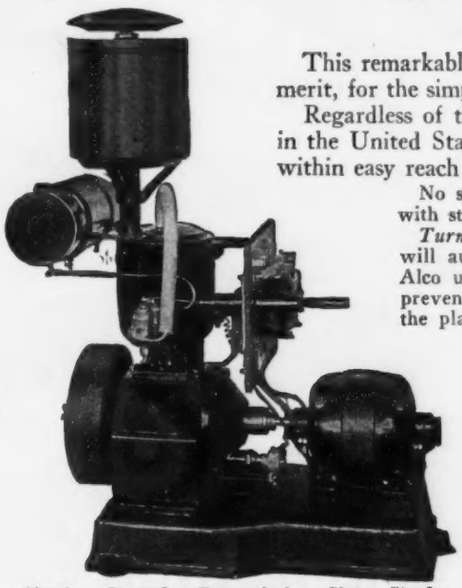
About 2,000 tons of steel constantly on hand; immediate shipments and lowest prices.

Tubular Steel Poles cost 50% more than Bates Steel Poles, yet Bates Poles are 100% stronger—will last 100% longer, cover a much broader range of adaptability and are much more artistic than Tubular Poles. Ask us to verify these facts.



Bates Expanded Steel Truss Company
208 So. La Salle St.
Chicago, Ill., U. S. A.

The Alco 110-Volt Full Automatic
Farm Lighting and Power Plant
No Batteries in Lighting Circuit



Simple — Rugged — Economical. Gives Steady, White Light. The current is supplied direct from a generator specially designed and made for us by the General Electric Co. There are no storage batteries in lighting circuit to get out of order or to recharge. Consumes fuel only while lights or power are actually used.

This remarkable plant has won a leading place in the World's market on its own merit, for the simple reason that the public wants a non-battery plant.

Regardless of the ALCO being the only *automatic* farm lighting and power plant in the United States of its kind, it is sold at a very reasonable price, which places it within easy reach of your buyers.

No special wiring necessary and no special fixtures required. Connect the Alco with standard 110-Volt wiring. The economy of this is obvious.

Turn on the lamp a block away, if you will, and the plant in the farm cellar will automatically start—*when you turn off the last light* the plant stops. The Alco uses fuel according to the number of lights burning, the electric governor preventing wastage. And the light at great distance is as clear as the light over the plant itself.

A Big Seller For Dealers

The Alco 110-Volt full automatic lighting and power plant is bound to become the "Ford" of the farm lighting field in point of sales; and the broad gauged men who join with us **now** are of the type who know a money-making proposition when they see it.

Territory is going fast, and if you want to get in on the ground floor, act **now.** The market for the Alco is ripe as a golden plum. Do you intend to let the other fellow beat you to the profits, or will you write or wire **now**—before you turn another page to find out if your territory is open.

Remember, the Alco is free from any expensive, bothersome storage batteries in the lighting current, and will supply real light, or it will furnish power to operate motors up to ¾ hp.

Send for descriptive folder today, and specify exact territory wanted

Automatic Light Company, Inc.
Exclusive Builders of Automatic Electric Generating Sets
Federal Building Suite 3 Ludington, Michigan

Alco — Automatic Light Co.

Full Cash Value
For Good Used Equipment

No man with a true knowledge of present-day conditions thinks of sacrificing good used equipment at "junk" prices. Nor is it necessary.

Buyers have come to appreciate that so-called "second-hand equipment in serviceable condition—whether out-grown or otherwise released by one establishment—can still give good service in another.

Old-time prejudice practically disappeared under pressure of war conditions. Thousands of new buyers were created and present high prices of new machinery continue to make a favorable market for used equipment.

If you have anything to sell Central Stations, Industrial Power Plants or other big users of Electrical Power Equipment, advertise it in the

SEARCHLIGHT SECTION
OF ELECTRICAL WORLD

The "Opportunity" Center of the Electrical Industry

Whether you want to buy or sell

Think "SEARCHLIGHT" First!

0090

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WOOD STAVE PIPE

—is received by engineers with marked favor everywhere. Many of the largest Irrigation Projects, Power Companies and Municipalities are served by this pipe—it is giving service in all parts of the world.

Our Engineering Staff is maintained for your convenience.

Continental Pipe Mfg. Co.

CONTINENTAL PIPE — GIVES WORLD WIDE SERVICE

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Pacific Coast Pipe Co., Seattle
Portland Wood Pipe Co., Portland
Washington Pipe & Foundry Co., Tacoma
National Tank & Pipe Co. (Pipe Dept. Only), Portland

METROPOLITAN ENGINEERING COMPANY
1250 Atlantic Ave., Brooklyn, N.Y.
Canadian Representative: Metropolitan Engineering Co.—Ltd
90 Sherbourne Street Toronto, Canada

Perfect Commutation for A.C. or D.C. Equipment-

NO SPARKING—NO LOSS OF POWER

when commutators or collector rings are occasionally smoothed down with the

Ideal Commutator Resurfacer

A manufactured abrasive block of uniform cutting quality, that cuts down high mica and ridges. Simply holding the Ideal against the commutator or rings occasionally, while in service, does the work. You don't have to shut down and remove armatures to turn them down on a lathe. No matter what size your equipment is, or what condition it is in, there is an Ideal Resurfacer of the proper size and roughness to put it in first class shape with very little time and labor.

TRY ONE OUT—FREE!

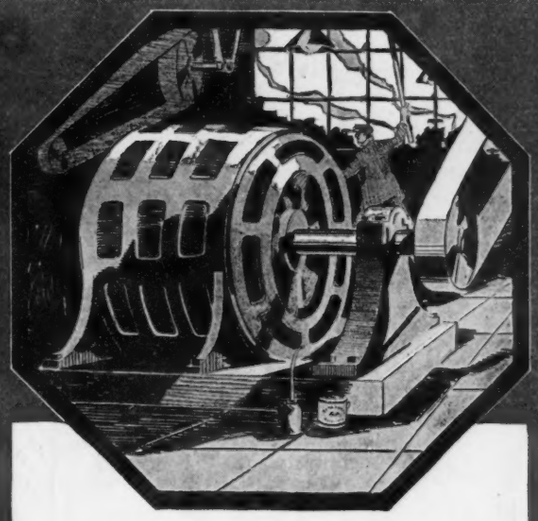
Fill out the coupon below and mail it in for a free trial of an IDEAL COMMUTATOR RESURFACER. If you don't like it you don't have to pay for it, just send it back C. O. D. Mail in the coupon now—it will not obligate you.

Ideal Commutator Dresser Co.
6 So. Dearborn Street Chicago

IDEAL COMMUTATOR DRESSER CO. E. W.—6-28-19
6 So. Dearborn St., Chicago

Gentlemen: Please send me an Ideal Commutator Resurfacer for free trial. It is understood that if I am not fully satisfied with it I will return it at your expense. I want to use it on equipment as follows:

Approx. R. P. M..... Diameter of Commutator or ring.....
Approx. width of Commutator or ring surface .....
Approx. distance between brush sets ..... Condition.....
Ring material (copper, steel, etc.) .....
My name is..... Position.....
Company.....
Company address.....
City..... State.....



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Millions of pounds of *VUL-COT* Fibre are used annually for the insulation of dynamos, motors, electrical instruments and appliances.

The insulating ability of *VUL-COT* Fibre and the ease with which it can be machined to any desired shape make it adaptable for many parts and purposes.

***VUL-COT* Fibre**
(A higher development of vulcanized cotton fibre)

can be turned, tapped, threaded, drilled, stamped, cut and sawed. It is economical not only because of its long wearing qualities, but also because of its low initial cost.

Perhaps in your plant a number of expensive materials can be replaced by *VUL-COT* Fibre. It is sold in sheets, rods and tubes, or machined to your specifications.

Write for samples and particulars.

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YOU can earn an extra day's pay, or more, every week by acting as our spare-time representative for the sale of **Croft's American Electrician's Handbook.**

The Handbook is really an electrical tool, and can be used to advantage on any job. That's what makes it so easy to sell.

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A Complete and Permanent Insulating Material

10,000 Volts to 100,000 Volts

(Durable—Practically Waterproof)

The Lasting Qualities of

BAKELITE DILECTO

make it a most desirable material, much superior to hard rubber or other brittle compounds.

It can be drilled, tapped or machined like metal and has a wonderful dielectric strength.

If you use insulation, you need BAKELITE-DILECTO.

Details and prices on request.

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The Continental Fibre Co.

Newark, Del.

Pittsburgh Office 316 Fourth Ave. New York Office 233 Broadway Chicago 322 S. Michigan Ave.
San Francisco Office, 525 Market St.
Los Angeles Office, 411 S. Main St.

SARP

In the Far East the treatment for the bite of a snake or sarp is to take a number of wheat cakes moulded in the shape of a serpent.

These are fed to the patient one by one.

As he consumes them he sits in front of his house and repeats, "I am not going to die—I am not going to die."

They do this *wishing* for results, instead of taking a shot of the good old American remedy for snake-bite.

And in much the same way you'll see an operator over here put some cheap-mix carbon brushes on a machine and hope for commutation—and hope—and hope.

—instead of putting on the old reliable prescribed Morganite and GETTING it.

There are always two ways to do a thing—and everybody knows it—and yet very little more than 50 per cent. do it right.

The Morgan Crucible Company

Main Office and Factory:
519 W. 38th St., New York City

DISTRICT AGENTS:
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When Sockets Make A Funny Crack—

t isn't quite so funny, not if you have to take them back and **thereby lose good money.**

Weatherproof sockets that split up one side and down the other make a fine opening for trouble.

Avoid loss of money on replacements by using sockets you won't have to replace.

Siemon Seamless WEATHERPROOF SOCKETS

THE jackets are molded in *one piece* and cannot split in two. They are *seamless* in making—crackproof in service.

The lamp base is secured in *solid porcelain* that firmly embeds the *solid brass center contact.* The wires are held in a water-tight grip of the composition jacket. Water cannot leak in—current can't leak out.

SOLID BUSHINGS FOR SOLID SERVICE

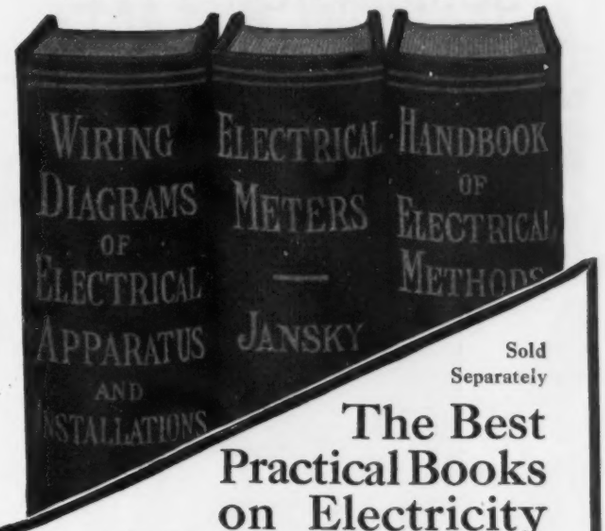
SIEMON Bushings have *continuous* threads that continually hold. They never stick going in—never break coming out, because they have no rough spots to chip, crack or bind on the socket threads.

Siemon Hard Rubber Corporation

BRIDGEPORT CONNECTICUT

USE THESE BOOKS for 10 days FREE

and see for yourself before you purchase them how useful they are



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370 *pages*, 6 *x* 9, 273 *illustrations*, $3.00 *net*, *postpaid.*

The first edition of Jansky's Electrical Meters received such wide distribution that a second edition was necessary. This new edition has been completely revised and 60 pages of new material added. Recent developments in meter design are covered and a new chapter on "Instrument Transformers" and instrument errors is included.

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Modern ways of solving every-day problems—as practical men have solved them.

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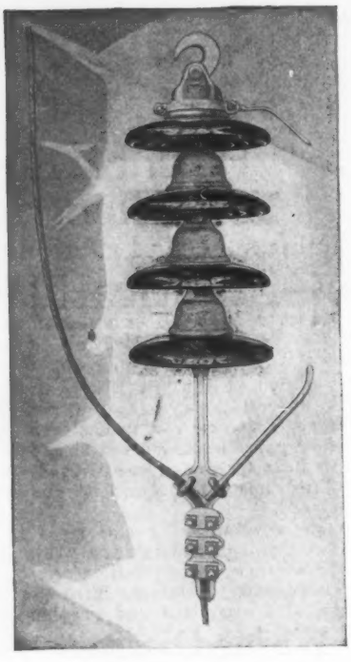
VICTOR

SUSPENSION TYPE INSULATORS FOR END STRAINS



Arcing Horns Increase Protection

VICTOR suspension Type Insulators installed in strain positions and with arcing horns, increase the protection to your lines many-fold and help to maintain the continuity of service which is essential to many manufacturing processes.

The Locke Insulator Mfg. Co.
Victor, N. Y.

It Does It's Own Fluxing

Do your soldering without the bother of a separate flux—use the solder that has the flux right in it—

KESTER ROSIN-CORE WIRE SOLDER

—now being used by thousands of electrical workers on both construction and repairing of telephones, switchboards, armatures, bells —on all kinds of electrical appliances.

KESTER ROSIN-CORE WIRE SOLDER has a core made up of little pockets filled with a rosin flux. When solder is melted off, just enough flux flows out to always insure a perfect bond. This flux is non-acid and consequently non-corrosive. It is made especially for electrical work.

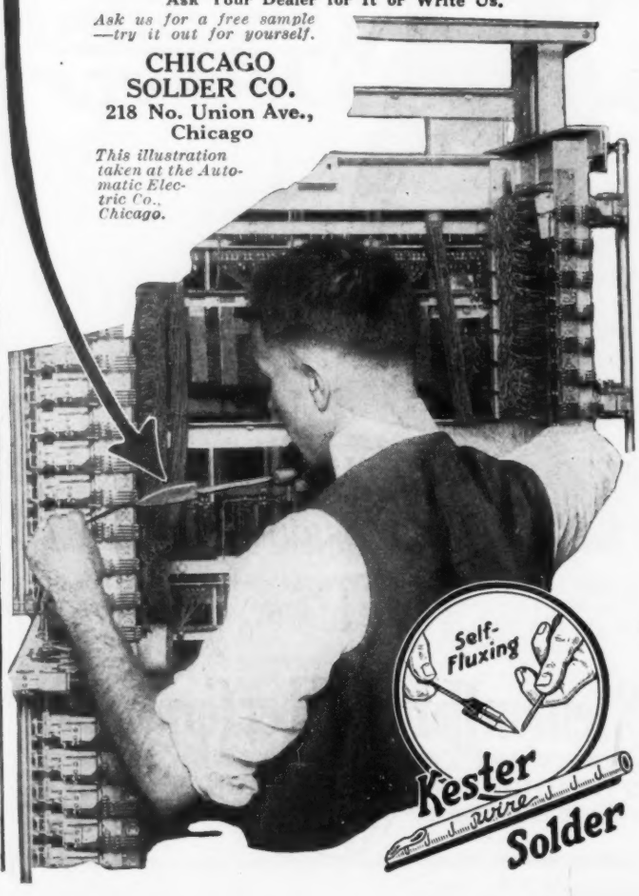
Sold in one-pound coils, in cartons, and on one, five and ten-pound spools.

Ask Your Dealer for It or Write Us.

Ask us for a free sample —try it out for yourself.

CHICAGO SOLDER CO.
218 No. Union Ave., Chicago

This illustration taken at the Automatic Electric Co., Chicago.



Dear Boss:

Have you considered, boss, that July 1st opens up a mighty serious problem for you and me—and the rest of the steady, sober, serious temperate workers of America?

How often you've heard of the chap who is "a wizard when he lets booze alone"—of the man who is a "whirlwind when sober"—who is "the finest fellow in the world when he's off the stuff."

We've all known about them—but they never offered us serious competition before because they were always soused. We simply got by because we stayed sober.

Do you realize that a flood of such genius goes on the market right now?

How can we stand up against the sudden lurch forward they'll give this old planet?

About the only thing they won't improve on is Nichrome because that's 20 years ahead now. Never mind, boss, the thirst is yet to come.

Nyl Chrome

DRIVER-HARRIS COMPANY

WESTERN OFFICE AND DEPOT CHICAGO 88 So. JEFFERSON ST.

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CANADIAN WORKS WALKERVILLE, ONT. CANADA

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Hasten Recovery with

AMBRINE

THE NEW FIRST AID

This war-proven wax dressing for burns, scalds and all surface wounds is becoming the most useful first-aid in Industrial Plants.

Injuries are made comfortable. Scars are eliminated. Functional disability is reduced. Compensation is saved.

Complete equipments are now available in several sizes—$47.50—$17.50—$7.50. Anyone can apply it.

Can you afford to be without Ambrine?

Ambrine Laboratories
Room 1903
347 Madison Ave.
New York City

Ambrine Laboratories,
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Gentlemen:
Send complete AMBRINE Emergency Case, including 5 lbs. AMBRINE and descriptive literature
Check enclosed for ——

1069

We Will Ship You a

PEERLESS TRANSFORMER

on Approval

and let you test it in your own factory, in any way you choose, and if it's not just as we represent and is not entirely satisfactory—just return it at our expense.

If PEERLESS transformers were not so carefully built and every detail of their manufacture supervised by men who have a direct financial interest in the firm, we might hesitate to make such an offer.

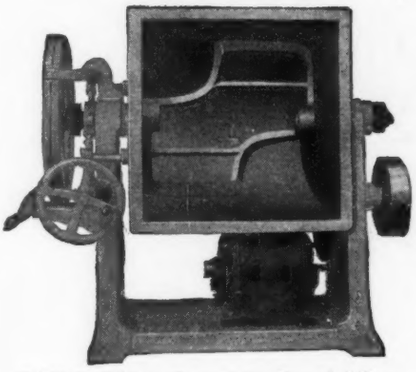
Experience as well as rigid tests has demonstrated that in quality and performance they are all that the name implies—PEERLESS.

Send for data and prices.

The Enterprise Electric Co.
Warren, Ohio

Century

Repulsion Start Induction Single Phase Motors



7½ H. P. Motor Geared for Dough Mixer

Are popular because they are dependable.

Their high starting torque makes them particularly desirable for operating direct and gear connected apparatus.

1/10 to 40 H.P.

They Keep-A-Running

Century Electric Company
St. Louis, Mo.
Sales Offices in Principal Cities

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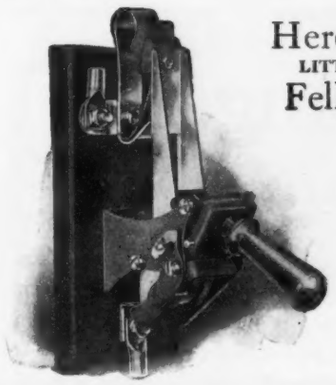
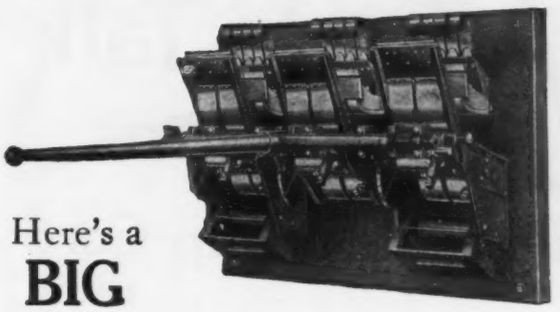


Here's a LITTLE Fellow

and



Here's a BIG One

ROLLER-SMITH BUILDS BOTH KINDS

Above is a cut showing the smallest breaker we make, a 3-ampere, 250-volt, single pole, plain overload, Industrial type circuit breaker.

It is described in our *new* Bulletin No. 520, which is of interest to all users of Circuit Breakers.

As a contrast to the little one, we show above a cut of a 4000-ampere, 250-volt, 3-pole, rigid arm, combined overload and under-voltage, Standard type circuit breaker with removable pole type handle.

It's a big one but we build them bigger than that!

If you need ANY kind of a circuit breaker, consult with our nearest office.

ROLLER-SMITH CO., 233 Broadway, New York, N.Y.

Works: **Bethlehem, Pa.**

CHICAGO: Monadnock Block **DETROIT: Majestic Bldg.** **CLEVELAND: Williamson Bldg.**

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BOSTON, 141 Milk St.
BUFFALO, 716 Ellicott Sq.
DENVER, 1633 Tremont St.
PHILADELPHIA, 963 Drexel Bldg.

ROLLER SMITH

Union Arcade Bldg., PITTSBURGH
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Contact Rail Material

Insulators, Shoes and Standards

A broad line of either under-running or over-running contact rail material for light or heavy shipyard or industrial cranes, industrial haulage systems and electric railways

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Manufacturer of Railway Material and Electrical Supplies

NEW YORK **PHILADELPHIA** **CHICAGO**
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Canadian Distributors: Lyman Tube & Supply Co., Montreal, Toronto, Winnipeg.

"3-in-1" Draft Gauge

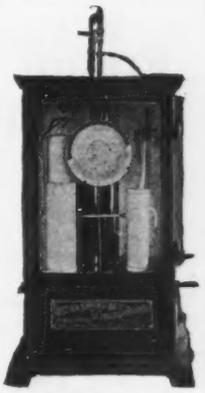
Accuracy Reliability Ruggedness Durability Service

These are the points to consider when buying boiler efficiency instruments.

"Precision" instruments excel in the first four points to a very marked degree.

Our service department thoroughly and promptly takes care of the last point.

Write for Catalog.



CO_2 Recorder

Precision Instrument Co.

Detroit, Michigan

A Trade Talk ON

Portable Lamp Cord

Portable cord for electric tools, for garage lamps and for similar purposes is subject to unusually hard service. Cord dragged over a cement floor must have a good outer braid for it to last long. "The PWp" portable, with its weatherproofed cotton outer braid is generally used for such purposes, but when the service is exceptionally hard, "Type PWp" does not wear long and replacements must be made frequently.

We manufacture what we term "Hard Usage Portable Cord." It is made substantially the same as "Type PWp" except that a heavy durable twine is used for the outer braid, this being thoroughly saturated in weatherproofing compound.

Write us for samples and prices.

Belden Manufacturing Company
Electrical Wires, Cables and Cordage
2301 South Western Ave., Chicago, Ill.
Eastern Warehouse: Metuchen, N. J.

Charles W. Baker, President Clarence B. Mitchell, Vice-Pres.

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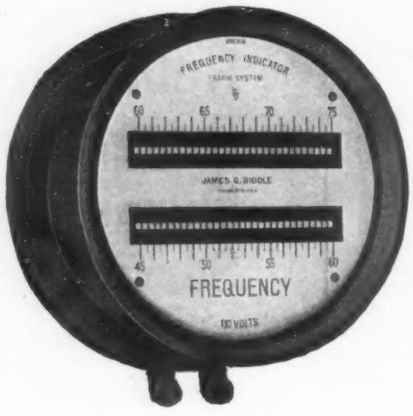
Sheet and Wire

We have been manufacturing this alloy with satisfaction for more than one year and can supply it in all shapes and sizes from large sheets down to very fine wires. The care with which it is made ensures uniformity of product. For high-class instruments its low temperature coefficient of resistance and thermoelectromotive force against copper render our alloy superior to any previously procurable.

BAKER & CO., INC.
PLATINUM

in all forms for all purposes
Scrap purchased or exchanged

Murray and Austin Sts., Newark, N. J.



Frahm Vibrating-Reed Frequency Meters

are specified and used by Engineers who require the *"very best."*

They contain no delicate springs, or moving parts —and are absolutely different in design from any other instruments on the American market.

High initial accuracy is sustained indefinitely—without recalibration.

Ask for Bulletin 815, *and investigate their merits.*

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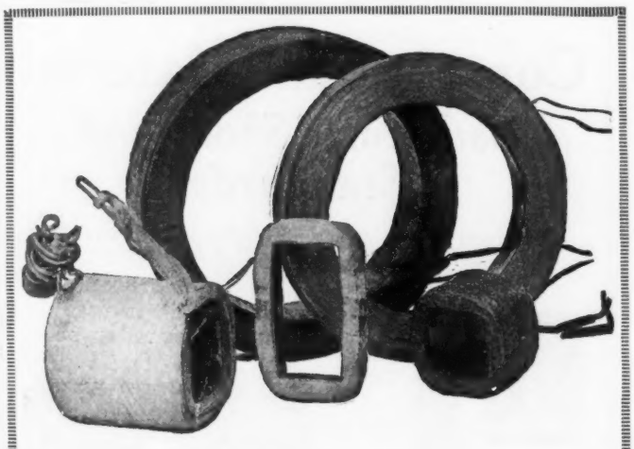

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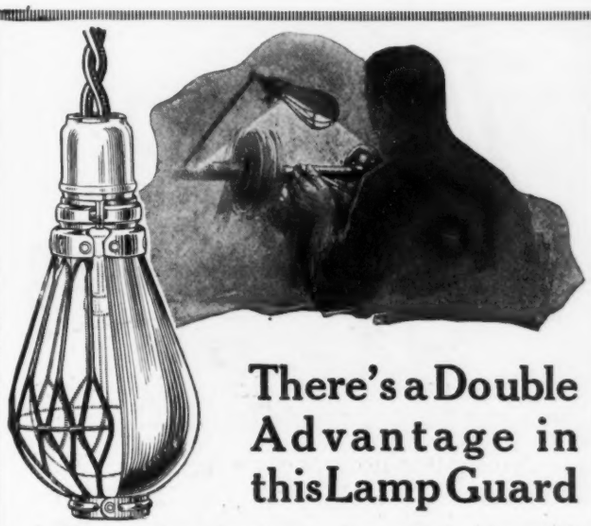

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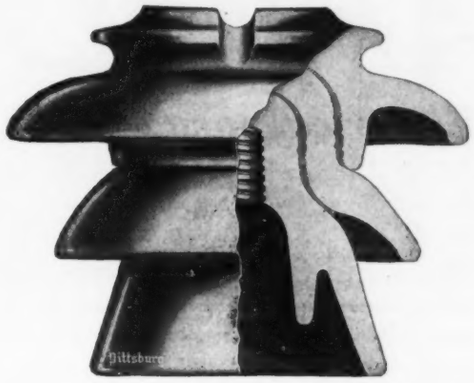

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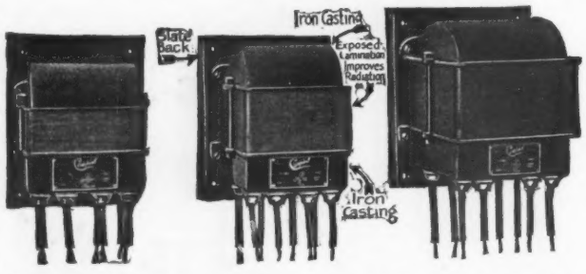

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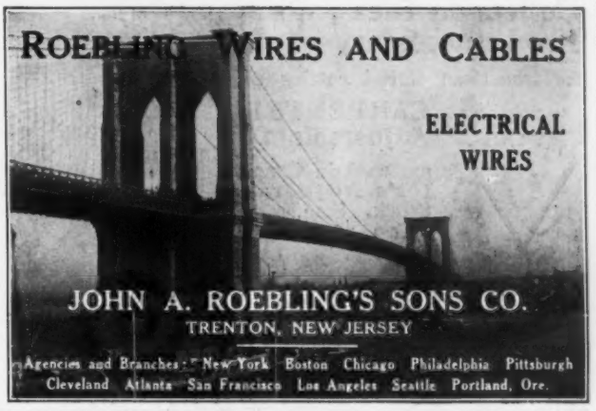
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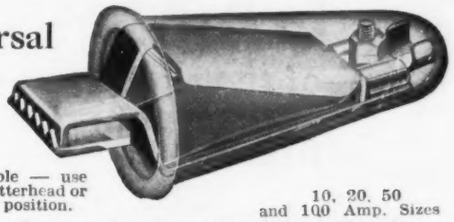

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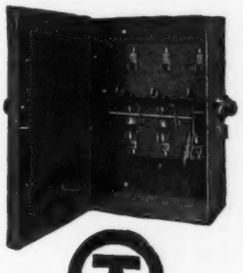

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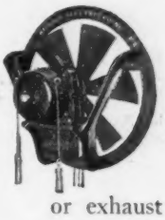

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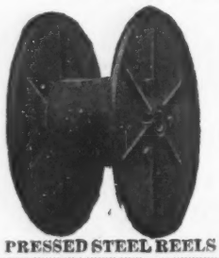

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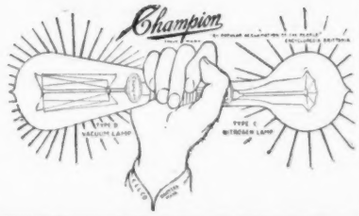

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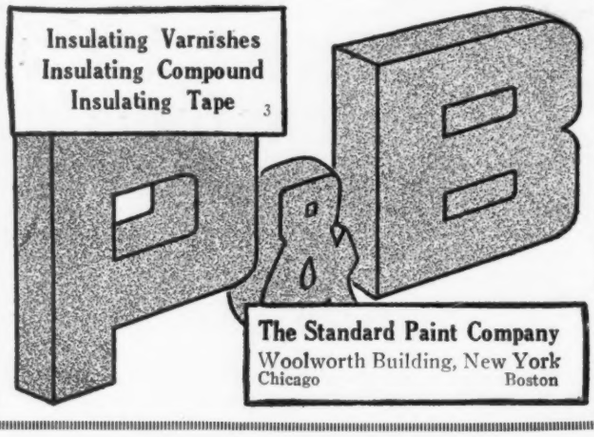

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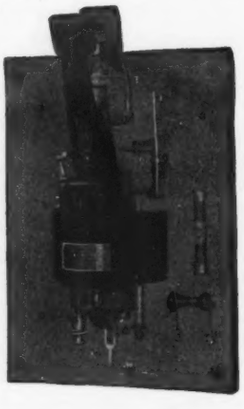

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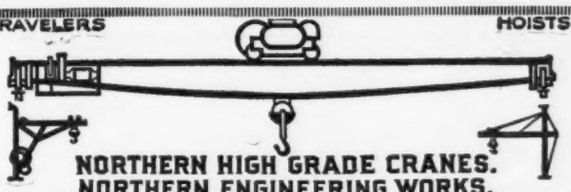

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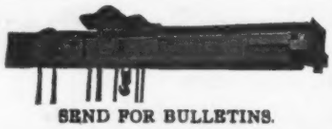

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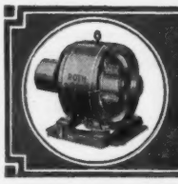

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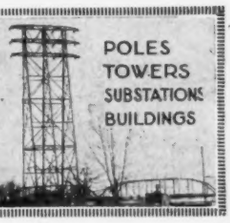

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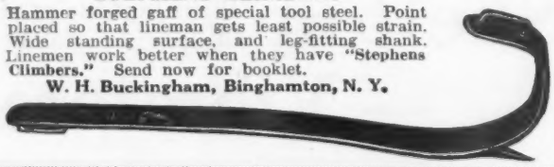

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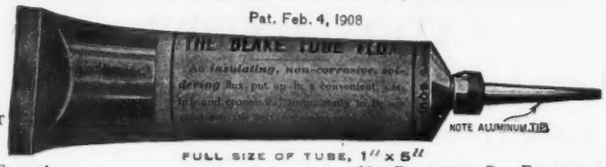

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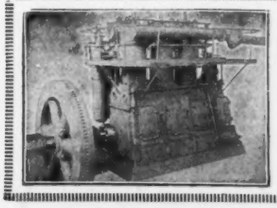

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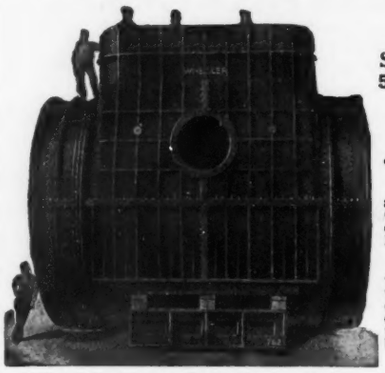

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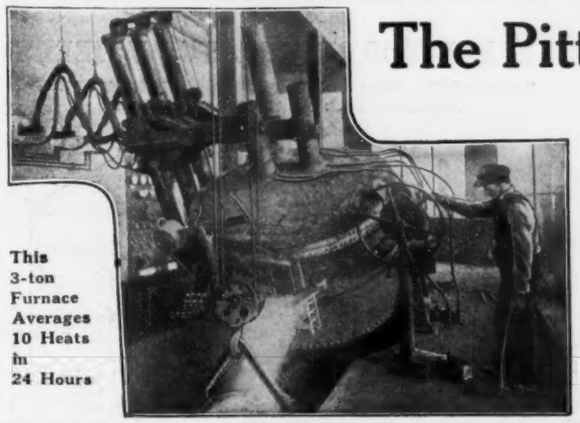

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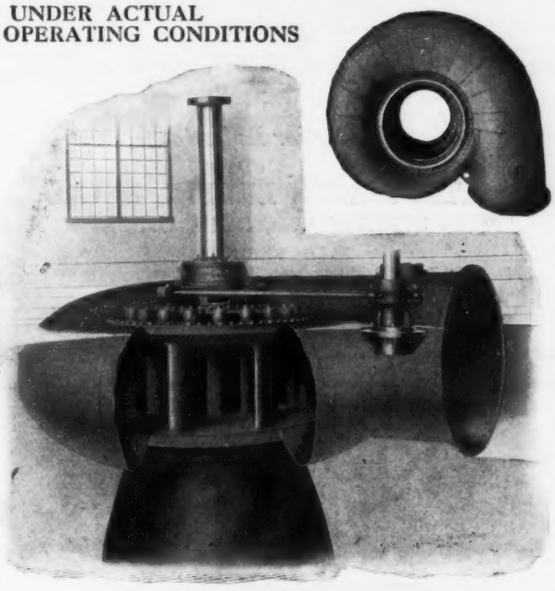

The accompanying illustration shows a single, vertical shaft wicket gate SMITH HYDRAULIC TURBINE in a plate steel scroll case with all gate operating mechanism on the outside. This unit is in successful operation under 60 ft. head developing 3,000 brake horse power at 240 revolutions. After installation it was tested by disinterested engineers and established the above performance record under actual operating conditions.

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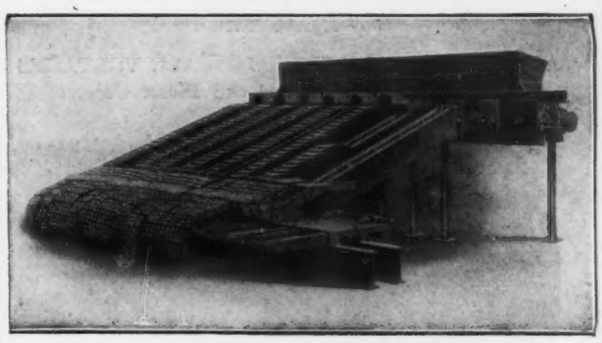

Perspective view of nine-retort stoker partially assembled

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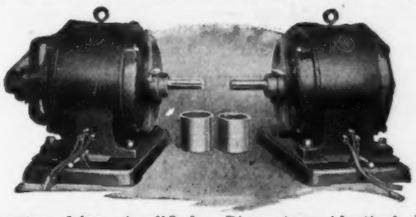

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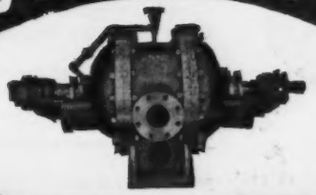

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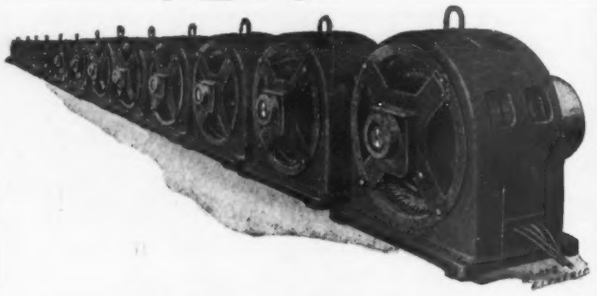

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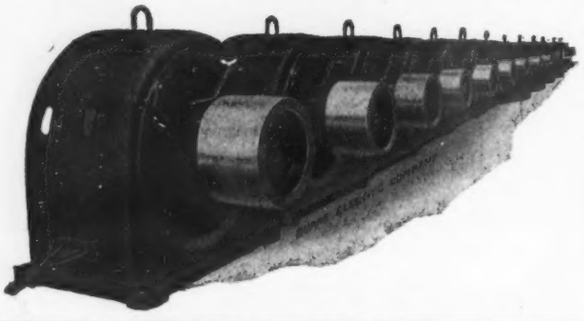

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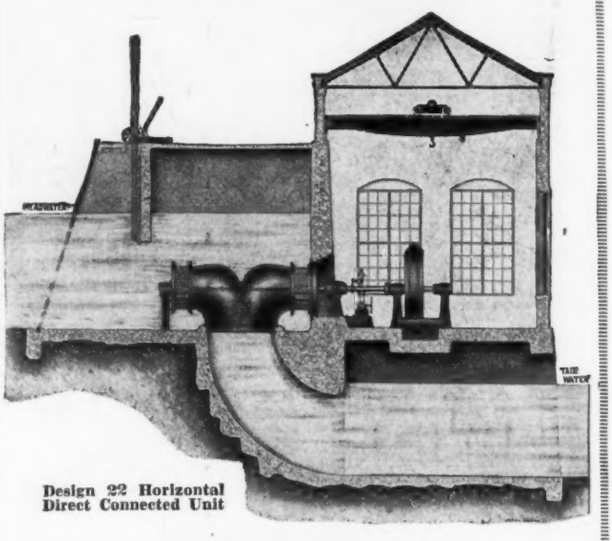

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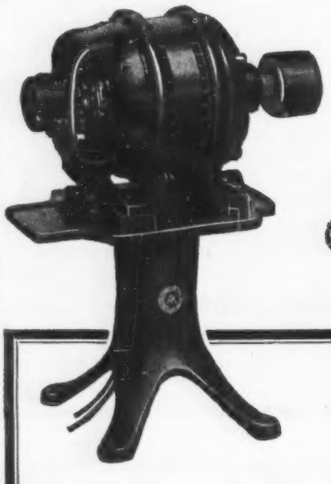

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Also Mfrs. of the "Martin" Rotary Converter

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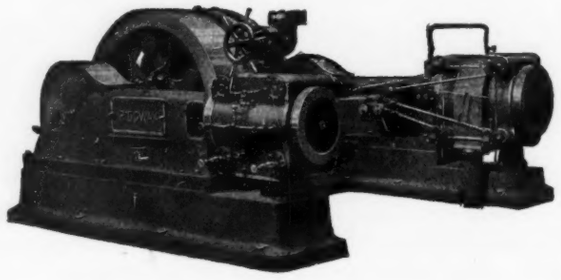
RIDGWAY UNITS



Are made as a single piece of machinery—
Not "hooked together"—
Not "bolted on"—
But Actually Made as a *Unit*.
That's why they run so silently, so smoothly and so economically.

Get the RIDGWAY Bulletins

Ridgway Dynamo & Engine Co.

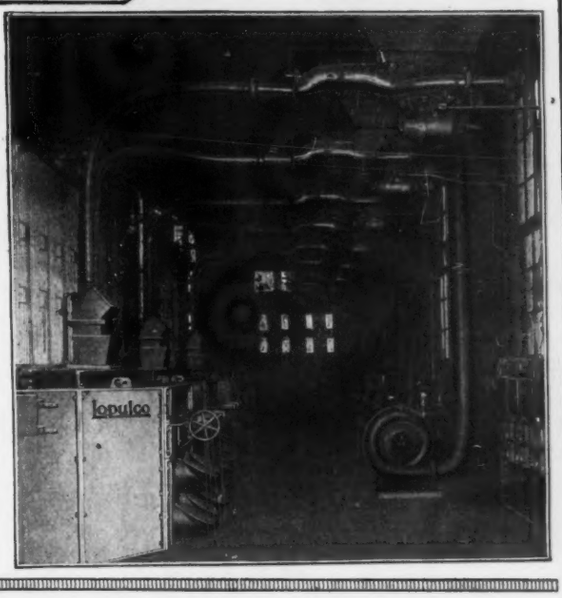
Ridgway, Pa.

· Lopulco Systems ·

"LOPULCO" produces
An ideal labor condition in your boiler room.

"LOPULCO" produces
More steam per pound of coal than any other method of firing.

"LOPULCO" produces
RESULTS



PULVERIZED FUEL EQUIPMENT CORPORATION
FOREIGN AGENCY-INTERNATIONAL PULVERIZED FUEL CORP.
Transportation Building, Montreal. 30 Church Street, New York

· Lopulco Systems ·

TENNEY SERVICE

Transmission Lines

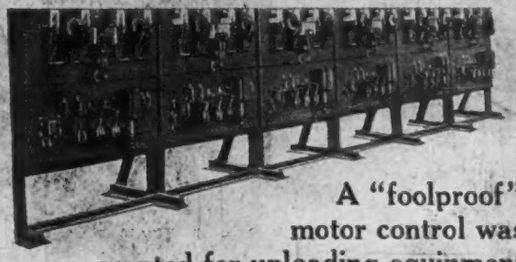
The Transmission Lines Division of our Engineering Department has been utilized by many public utility companies to design transmission systems, obtain the necessary rights of way, and construct the lines.

The broad experience thus gained by this department is at *your* disposal, either in connection with proposed transmission lines or extensions to existing systems.

Our booklet "Tenney Service" on request.

Charles H. Tenney & Company
Engineers *Managers* *Accountants*
201 Devonshire Street, Boston, Mass.

SUNDH'S
SPECIAL PANELS
built to meet the requirements of a good specification



A "foolproof" motor control was wanted for unloading equipment

The case was that of a ship loading and unloading device installed on an important pier.

It was necessary that this apparatus should be handled by rough and careless "dock wallopers." Consequently a motor control equipment was required that would be practically foolproof—an equipment, in fact, that would enable the owners to forget the human element altogether.

The illustration shows a few of the 34 special Full Magnet Control Reversible with Dynamic Brakes and Overload equipments supplied by us to meet the above requirements.

Ask SUNDH service to solve YOUR motor control problem.

—so they put it up to SUNDH

Sundh Electric Co.
Ave. C & Parkhurst St., Newark, N. J.
New York Office: 51 E. 42nd St.

First National Bank, Pittsburgh, Pa.
H. J. Kaufman, Peoples Gas Bldg., Chicago, Ill.

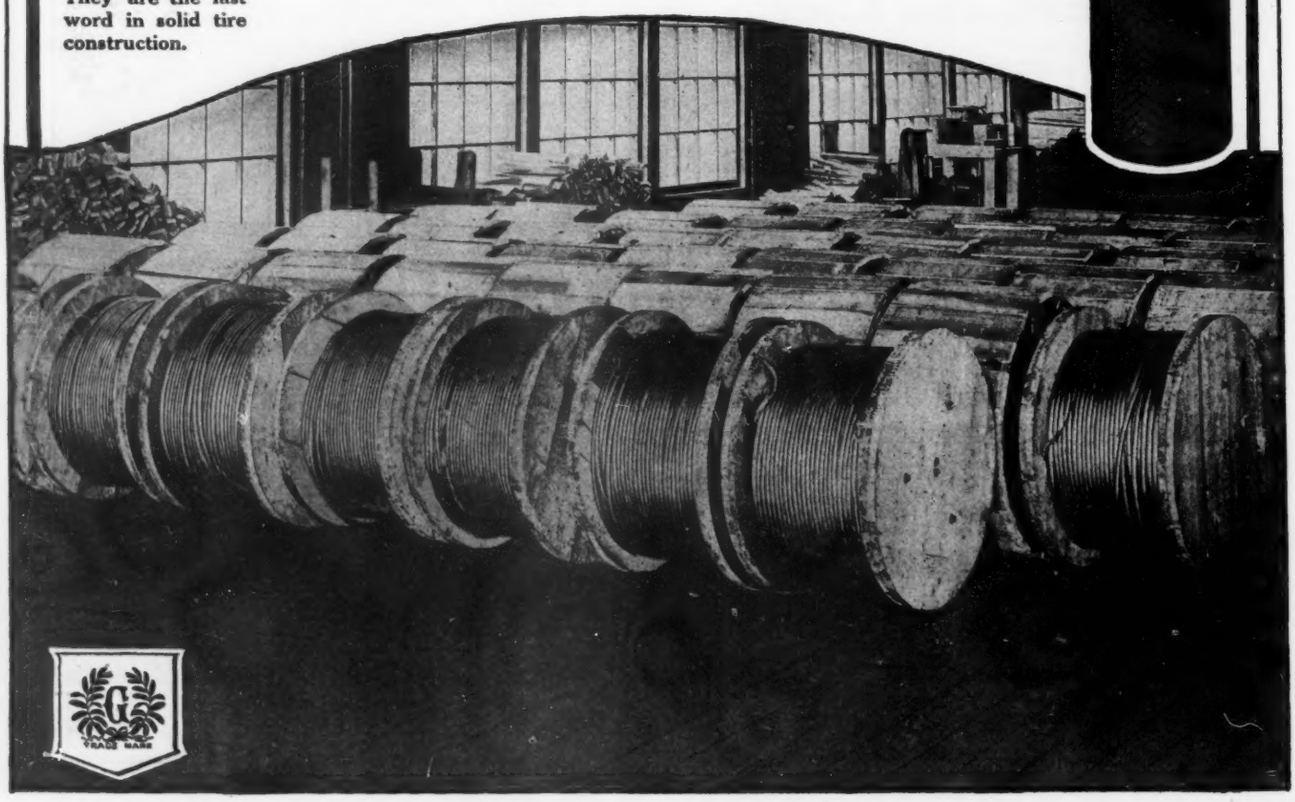
Send Us Your Specifications

GOODRICH
"DIAMOND"
WIRES and CABLES

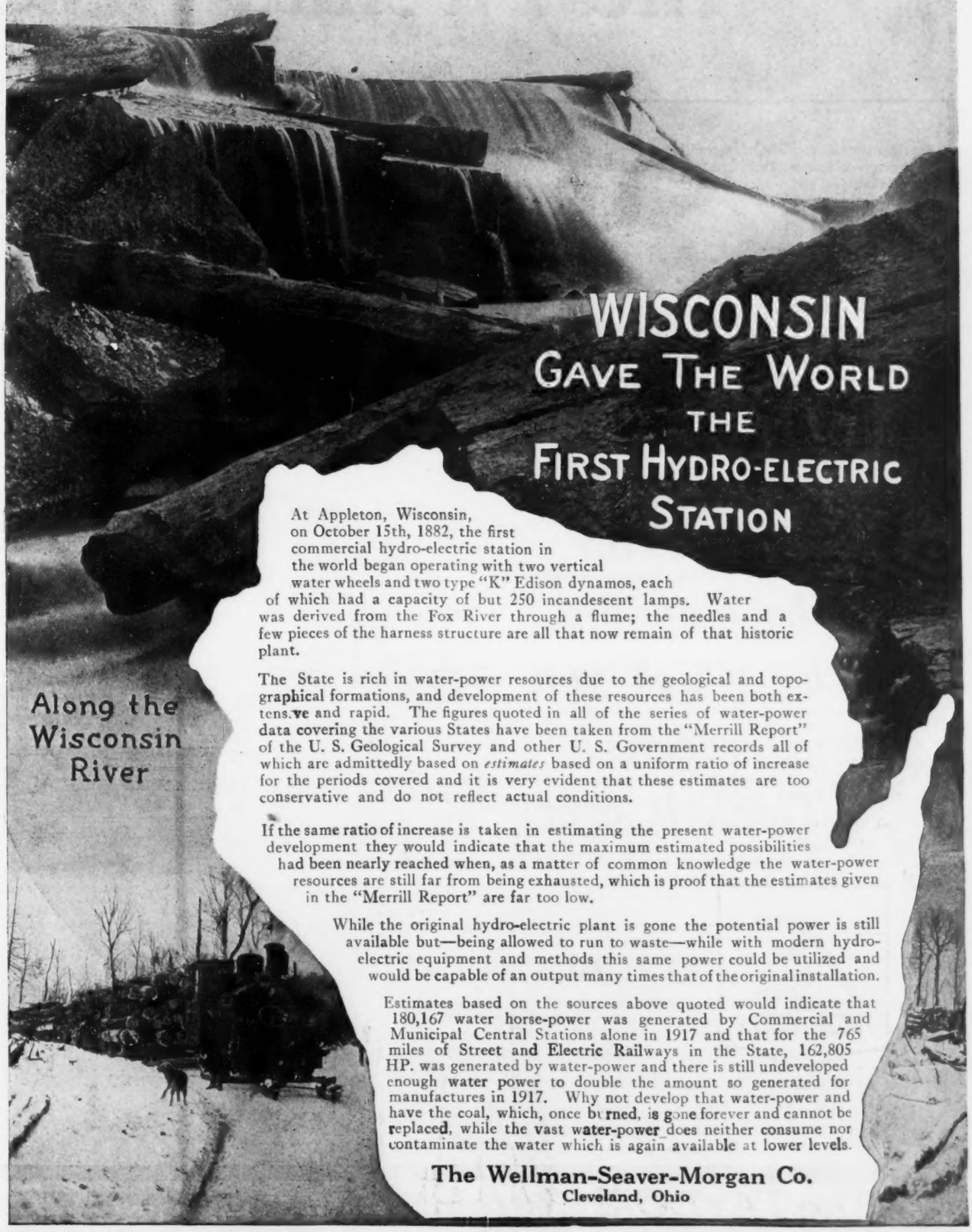
IT IS THIS UTTER DEPENDABILITY of Goodrich "Diamond" Wires and Cables that finds them specified by Architects and Builders *"throughout"* in their most important contracts.

The B. F. Goodrich Rubber Co.
The City of Goodrich—Akron, Ohio

Goodrich De Luxe Truck Tires cut tire costs and swell mileage figures. They are the last word in solid tire construction.



WHITE COAL THE SOLUTION OF THE POWER PROBLEM



WISCONSIN GAVE THE WORLD THE FIRST HYDRO-ELECTRIC STATION

At Appleton, Wisconsin, on October 15th, 1882, the first commercial hydro-electric station in the world began operating with two vertical water wheels and two type "K" Edison dynamos, each of which had a capacity of but 250 incandescent lamps. Water was derived from the Fox River through a flume; the needles and a few pieces of the harness structure are all that now remain of that historic plant.

Along the Wisconsin River

The State is rich in water-power resources due to the geological and topographical formations, and development of these resources has been both extensive and rapid. The figures quoted in all of the series of water-power data covering the various States have been taken from the "Merrill Report" of the U. S. Geological Survey and other U. S. Government records all of which are admittedly based on *estimates* based on a uniform ratio of increase for the periods covered and it is very evident that these estimates are too conservative and do not reflect actual conditions.

If the same ratio of increase is taken in estimating the present water-power development they would indicate that the maximum estimated possibilities had been nearly reached when, as a matter of common knowledge the water-power resources are still far from being exhausted, which is proof that the estimates given in the "Merrill Report" are far too low.

While the original hydro-electric plant is gone the potential power is still available but—being allowed to run to waste—while with modern hydro-electric equipment and methods this same power could be utilized and would be capable of an output many times that of the original installation.

Estimates based on the sources above quoted would indicate that 180,167 water horse-power was generated by Commercial and Municipal Central Stations alone in 1917 and that for the 765 miles of Street and Electric Railways in the State, 162,805 HP. was generated by water-power and there is still undeveloped enough water power to double the amount so generated for manufactures in 1917. Why not develop that water-power and have the coal, which, once burned, is gone forever and cannot be replaced, while the vast water-power does neither consume nor contaminate the water which is again available at lower levels.

The Wellman-Seaver-Morgan Co.
Cleveland, Ohio

Combustion efficiency the Fireman when

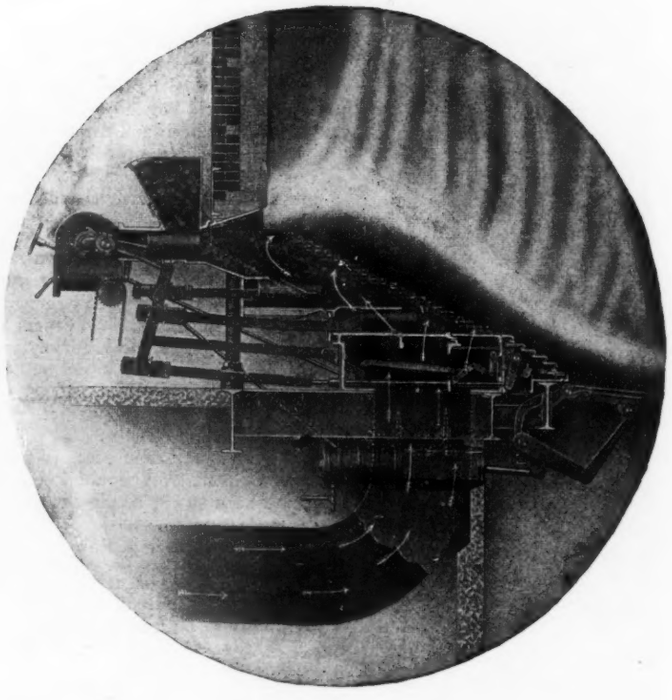
To obtain the best commercial combustion of bituminous coal requires a low distillation temperature, thorough mixture of the combustibles and oxygen, and rapid preparation of the combustible hydrocarbons for burning.

In practical work the results obtained depend upon the load, the furnace, the chimney and the fireman. With a good fireman and a bad combination of other conditions, it is possible to obtain fairly good results, but with a poor fireman, no matter how favorable other conditions may be, the results will gradually gravitate to the fireman's standard. Therefore the fireman is the most important factor in heat generation.

From article in POWER

Is Your Plant Handicapped THIS Way?

Or is THIS the standard by which you get results? Think it over!



The TAYLOR System of Efficient Boiler Firing

does not depend upon you are using

The Taylor Stoker

Here it is anew—the old, old story.

"The Fireman is the most important factor in heat generation"—everything gravitates to *his* standard and you stand helpless in spite of the best equipment.

Sad—but true—*until you eliminate the shovel-swinging "fireman."*

By eliminating the "fireman" from the boiler room we mean exactly the same thing as eliminating the man who used to swing the old-fashioned scythe from agriculture, or the "man with the hoe" from construction work.

For instance, where would agriculture be now if we worked with the small scythe and the horse-plow instead of with the mighty gang-plow and the reaping-machine?

Where would construction be if contractors let their men mix concrete with hoes and rakes instead of the power-driven concrete-mixer?

These industries still employ thousands of men—but they get better results by keeping up to the *standard of the machine* rather than down to the "man-power" standard.

And by making it EASIER for their men to do *better,* more intelligent, more interesting, less slave-like work, they get better COOPERATION.

When YOU eliminate the "fireman" (the man who handles the primitive shovel, slicebar and rake), and give this man the TAYLOR STOKER to work with,—you will accomplish the results we speak of. You will make him equal to *five or more men.* And one point more. The Taylor Stoker, having forced draft, is not dependent on *the chimney,* either.

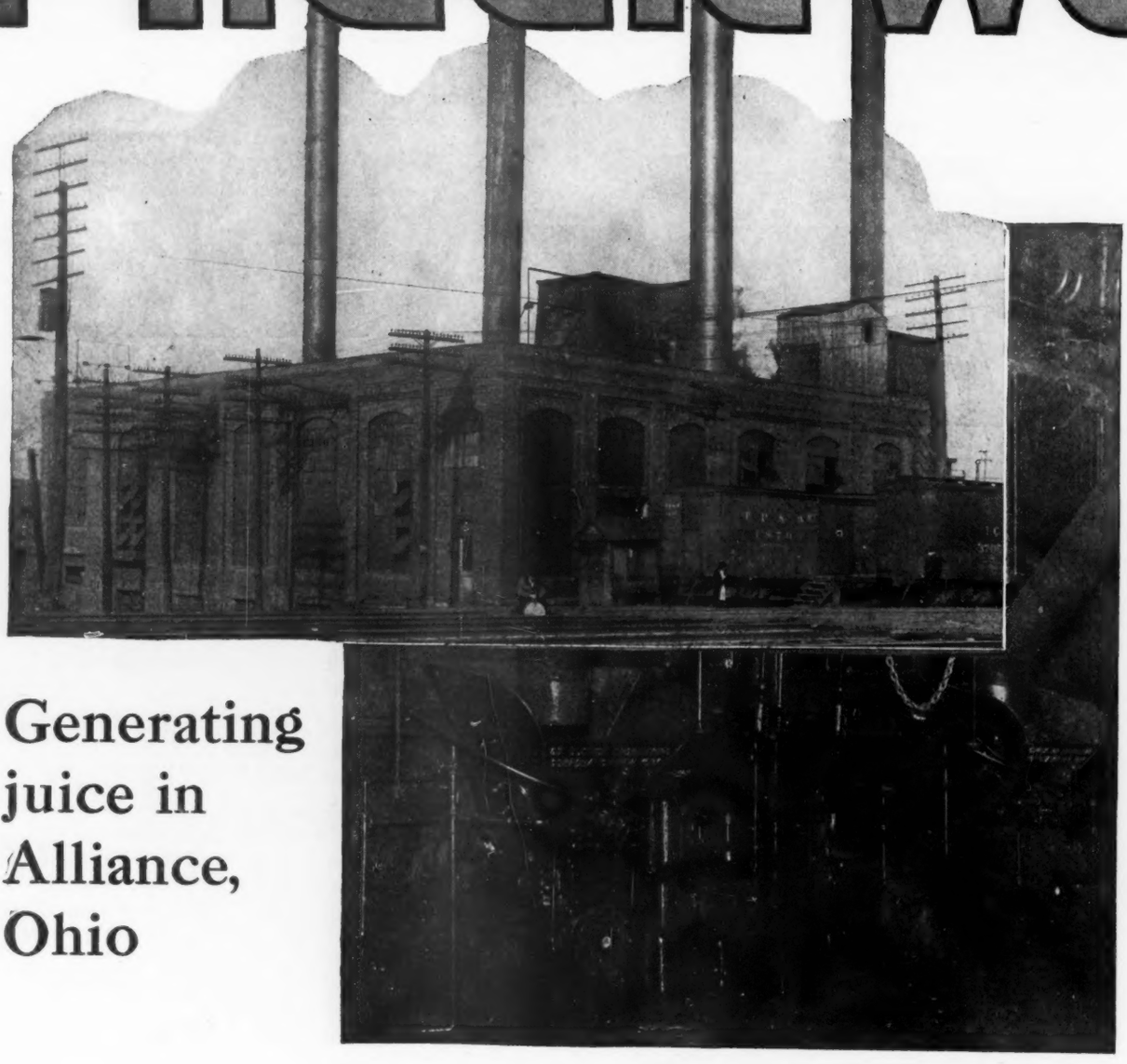
American Engineering Company

Philadelphia

Foreign Licensee: Babcock & Wilcox, Ltd., Oriel House, Farringdon St., London, England

The Taylor Stoker

Middle West



Generating juice in Alliance, Ohio

"Generating juice in Indiana"

"Generating juice in the Pine Tree State"

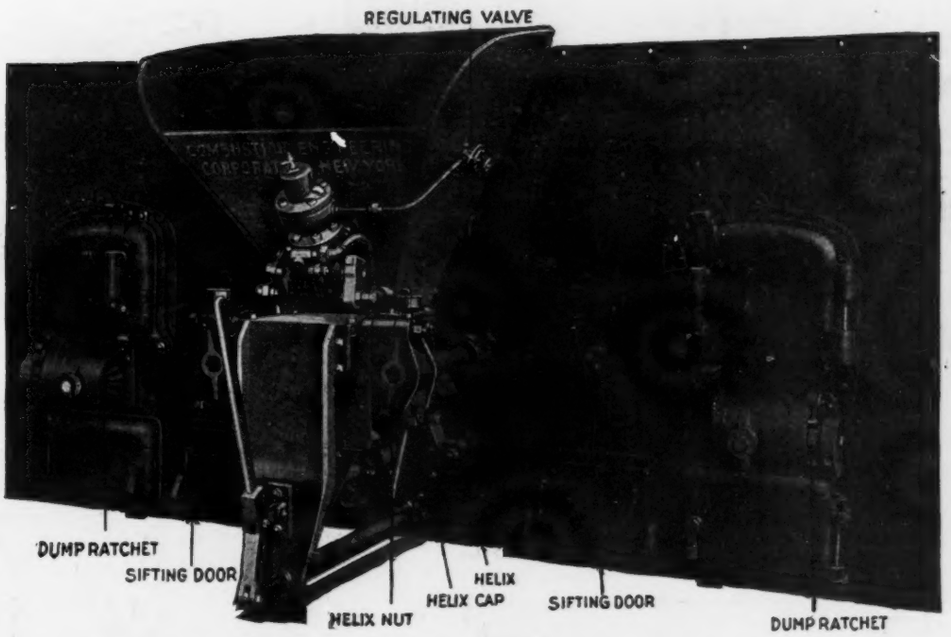
"Generating juice in the Hoosier State"

Generating juice in Sheboygan

tern Coals

TYPE "E" STOKERS

in this plant carry the light, heat and power loads



COMBUSTION ENGINEERING CORPORATION

11 Broadway, New York City

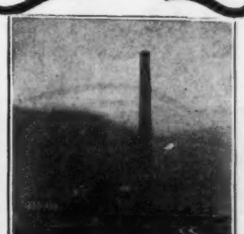
Owners and Manufacturers of

Type "E" Stokers—for Bituminous Coal **The Grieve Grate—Hand-Firing**

Coxe Stokers—Anthracite Coal and Coke Breeze

PHILADELPHIA, PA. PITTSBURGH, PA. MINNEAPOLIS, MINN. BIRMINGHAM, ALA.
HAZLETON, PA. BOSTON, MASS. CHICAGO, ILL. SEATTLE, WASH. SALT LAKE CITY, UTAH
ALBANY, N. Y. OMAHA, NEB. TAYLOR ENGINEERING CO., VANCOUVER, B. C.

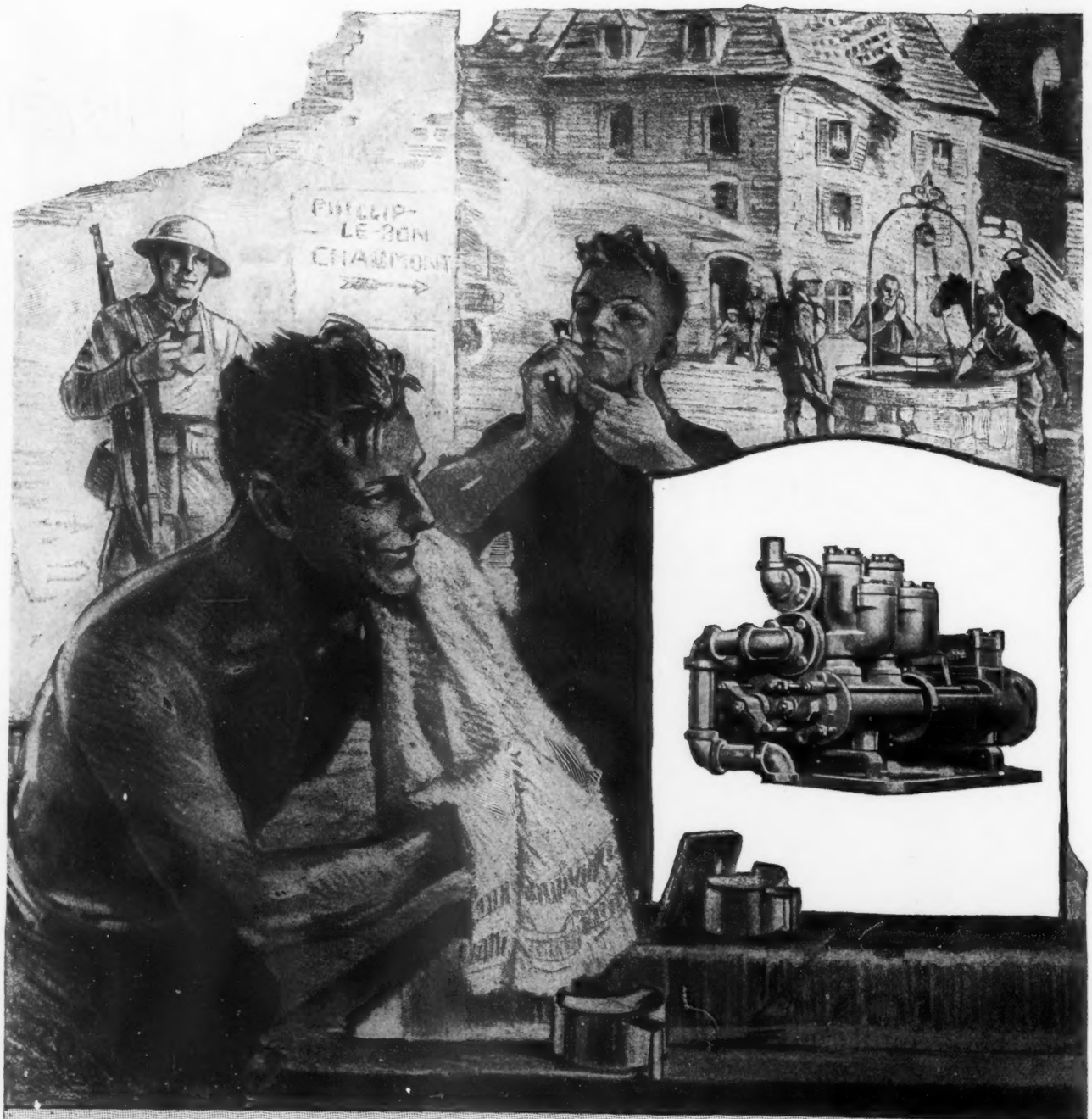
"Generating juice in New Bedford"



"Generating juice in the Backwoods"

"Generating juice in Iowa"

"Generating juice in the Buckeye State"



PUMPS–COMPRESSORS–CONDENSERS–METERS–

WORTHINGTON

Worthington Works
Harrison, N. J.
Blake & Knowles Works
East Cambridge, Mass.
Deane Works
Holyoke, Mass.
Hazleton Works
Hazleton, Pa.

Even when they shaved Worthington helped

"SHOES shined and faces shaved"—if any one phrase from the orders of the day will be remembered, that is it.

With the American soldier the morning shave was a habit, even under fire, so Worthington's part in making razor blades at once assumes a peculiar importance.

And while Worthington compressors and vacuum pumps in South Boston were helping to make razor blades, other Worthington equipment was playing its part in factories making soap, steel mirrors, brushes, and indeed practically everything that went into the recruit kit.

It is significant of Worthington's ability to meet emergencies that, although the eight Worthington factories were all delivering unprecedented quantities of war materials, it was still possible for them to supply the wants of those industries essential to everyday life.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities

-OIL & GAS ENGINES—MINING MACHINERY

WORTHINGTON

Snow-Holly Works
Buffalo, N. Y.
Laidlaw Works
Cincinnati, Ohio
Power & Mining Works
Cudahy, Wis.
Gas Engine Works
Cudahy, Wis.

Twenty-Six Stokers!

—Four Repeat Orders

Kansas City Light and Power Co., Kansas City, Mo.

AND when the Kansas City Light and power Company repeats four times you can rest assured that the favored equipment is "delivering the goods."

With their Green Chain Grates this big station can burn Cherokee, Kansas, Oklahoma and Missouri coals—they are the cheapest and most logical steam coals of this district. Although these coals average 20% ash, 200% of rating is maintained as long as required. Efficiency 70%.

Here is an installation that is burning a wide range of coals that are notoriously difficult to fire satisfactorily—burning these coals without forming clinkers and without producing smoke. It is but typical of hundreds of Green equipped plants. It is but representative of hundreds of plants where Green Engineers have properly adapted stokers and furnace design to meet the conditions and requirements of that plant. Successful installations are the inevitable result.

Driving engine requires 30 lb. steam per hour for largest stoker—no other steam consuming auxiliaries—all efficiency figures quoted are net.

No clinkers—least attendant labor.

Green Engineering Co.

Main Offices and Shops:

East Chicago, Indiana

The new Green Book, "PROGRESSIVE COMBUSTION" will be a real addition to your technical library. Its 92 pages are filled with information of vital interest to owners, directors and engineers of power plants. A copy will be forwarded to interested executives at request upon their company letterhead. Send your request to Dept. B.

Backed by 21 Years of Specialized Experience

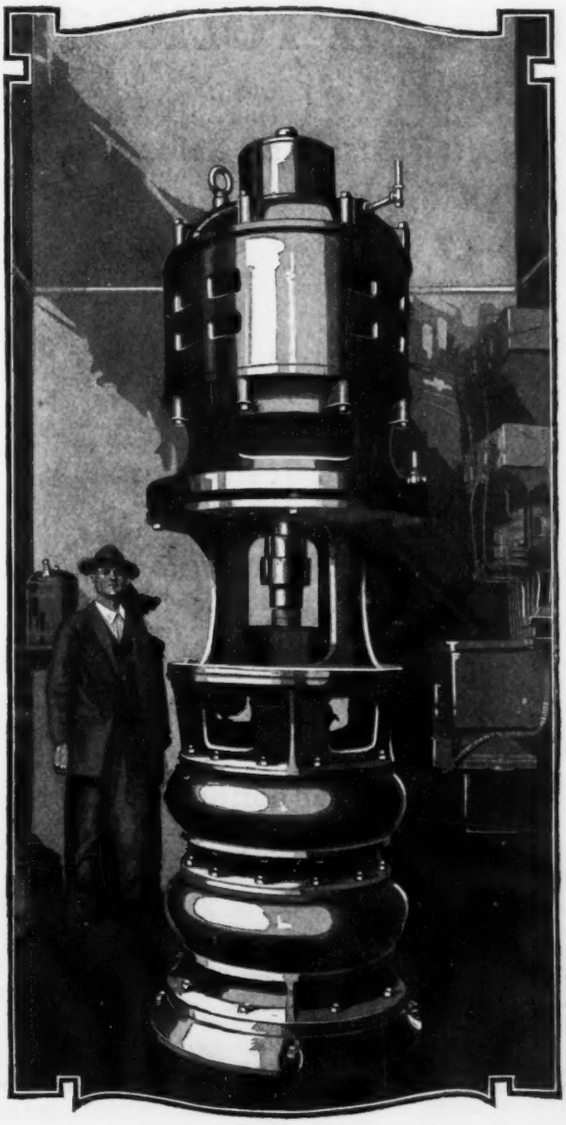
GREEN Sealflex Arches
GREEN Pressure Waterbacks
GREEN Steam Jet Ash Conveyor
GREEN Materials Transfer and Storage Hopper

GREEN CHAIN GRATES

MIDWEST
Dependable Power

Midwest Engine Company Products

Midwest—Diesel Engines
Midwest—Hvid Oil Engines
Midwest—Parsons Turbines (*Reaction Type*)
Midwest—Wait Turbines (*Impulse Type*)
Midwest—Hill Centrifugal and Reciprocating Pumps and Auxiliaries
Werkspoor Diesel—American Licensees



THERE is a Midwest pumping equipment to meet every condition—and in each case that equipment guarantees maximum dependability with minimum maintenance expense.

For instance, if you need equipment for deep-well pumping, where it is necessary to pump against high pressure after the water is brought to the surface, you will be interested in the equipment shown here—one of eight Midwest pumps of this type doing service for the city of Canton, Ohio.

Each of these units consists of an 8-inch, 2 stage surface pump in combination with a No. 10 Axial deep-well pump, with a capacity of 1000 g. p. m. against 100 pounds pressure in the mains.

The records of the city of Canton show that with practically no maintenance cost these pumps have given continuous satisfactory service.

Bring your own pumping problems to our engineering department, or see our representatives in all large cities.

New York Office—111 Broadway
New Orleans Office—617 Maison-Blanche Building

MIDWEST
ENGINE COMPANY
INDIANAPOLIS, U. S. A.

Which is the Worse "Profiteer"

The man who refuses to *sell* on a fair basis and holds out for a higher price in a "seller's market"?

Or the man who refuses to *buy* on a fair basis and holds out for a lower price in a "buyer's market"?

Both trade on the necessities of others.

Both take advantage of conditions to speculate at the "other fellow's" expense. Don't be a "buying profiteer."

If you need anything and it is offered to you at a fair price, present market conditions considered, *buy it.*

Unreasonable prices can not be successfully maintained but waiting for prices to fall below costs of production can result only in general loss to all

Keep business going. Carry on. If everybody keeps busy and gives the other fellow a fair deal everybody will make their turnover and the process of adjustment from war conditions to peace conditions will be so gradual that we will never feel a single bump.

Let's Go!

MASTER Garage Pump

"As Handy As Electric Lights!"

THAT'S what the garage men say. The Master Garage Pump has proven itself finally and completely as necessary garage equipment. Large numbers of electrical contractors who are equipping public and private garages say the Master Garage Pump is just as much a part of their installation as the lights and switches.

You don't need anything but the ordinary electric current for the Master Garage Pump. You get full pressure immediately and *there is no tank.*

The simplicity of this pump—the absolute service of the specially designed General Electric motor when it is plugged into an ordinary electric circuit—has made a big appeal to the trade.

The Master Garage Pump is a remarkably powerful yet compact two cylinder pump mounted on a neat metal truck. Pistons are of special steel, carefully hardened and ground to exact size and lapped into the cylinders, insuring positive pressure always. Will develop 150 pounds pressure if desired. No rubber or leather packing rings to wear or leak.

Two motor-driven models: "P", price $100.00, designed primarily for the private garage or for small public garages of from fifteen to twenty cars. Model "W", price $150.00, is for larger garages. A third Model, "Y", is belt-driven, price $60.00 (without motor). Prices given are for D. C. motors.

Master Garage Pumps are absolutely guaranteed for one year, by a company of nearly half a century's standing, and if you do not find your pump entirely satisfactory after ten days' trial, we will gladly return your money. With ordinary care and usage they should last ten years. Put a Master Garage Pump into the next garage you equip.

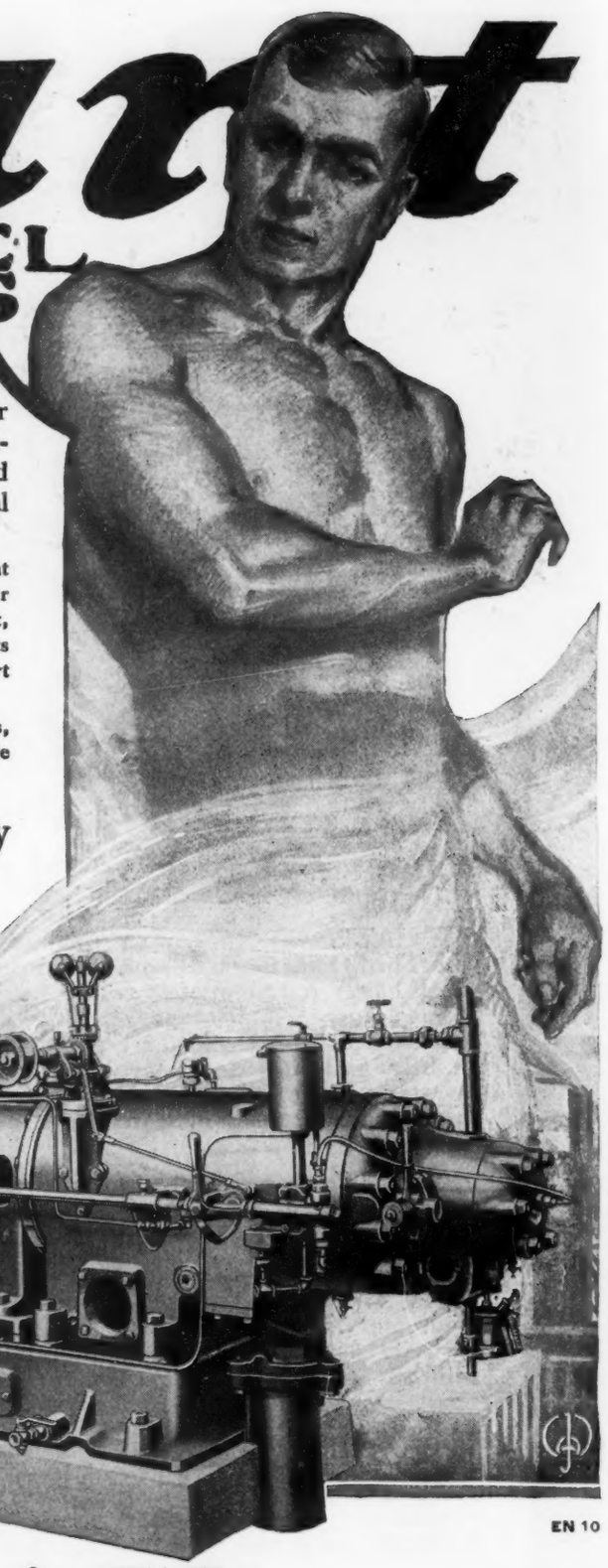
Send for our agents' proposition and get started at once on this fast-selling line.

Hartford Machine Screw Co.

Hartford, Conn.

New York Detroit San Francisco Richmond, Va.

Giant
SEMI-DIESEL OIL ENGINES

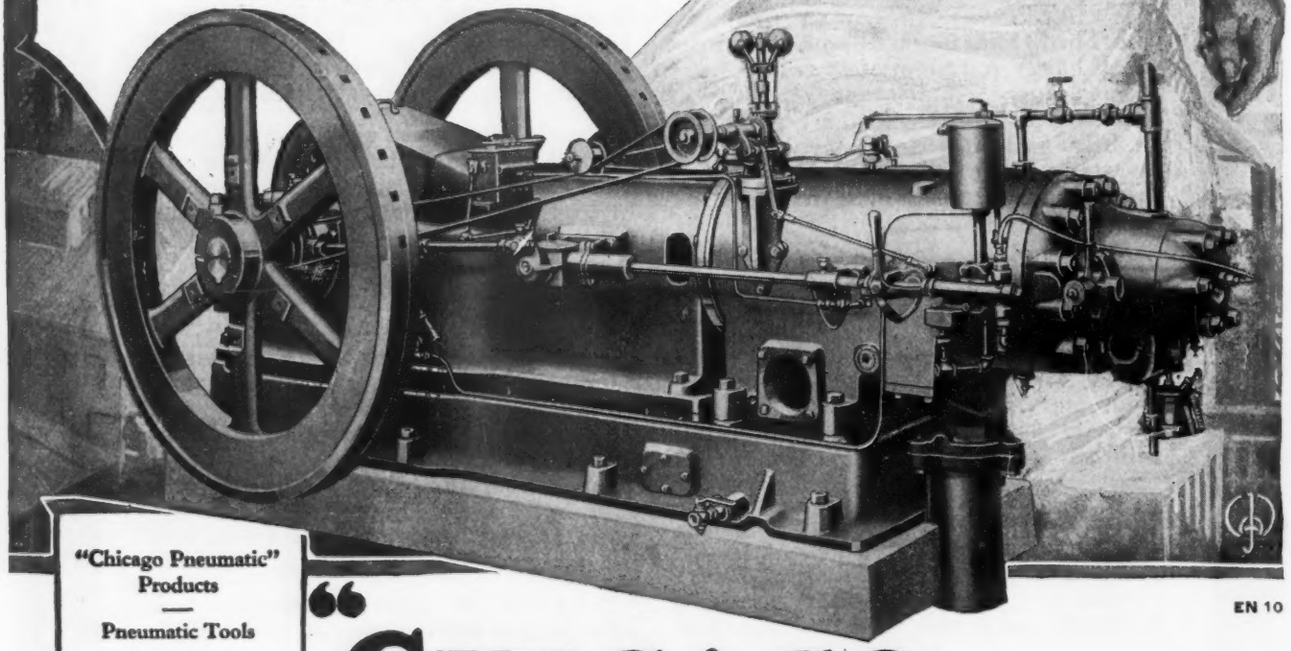


POWER costs of one-half cent per horse power hour are common amongst users of Giant Semi-Diesel Fuel Oil Engines. The economy and dependability of this prime mover for general purposes are proven facts.

Records are available showing the performance of Giant Engines under service conditions similar to yours. Put your individual power problem, without obligation on your part, before our experienced engineers. Your present power costs may be such that a Giant Engine will pay for itself within a short time—and then pay dividends on the investment.

Giant Oil Engines utilize the lower grades of cheap fuel oils, are built in capacities from 12 to 160 horse power, both single and duplex types. Ask for Bulletin 34-W.

Chicago Pneumatic Tool Company
1087 Fisher Building, Chicago, Illinois
Branches all over the world



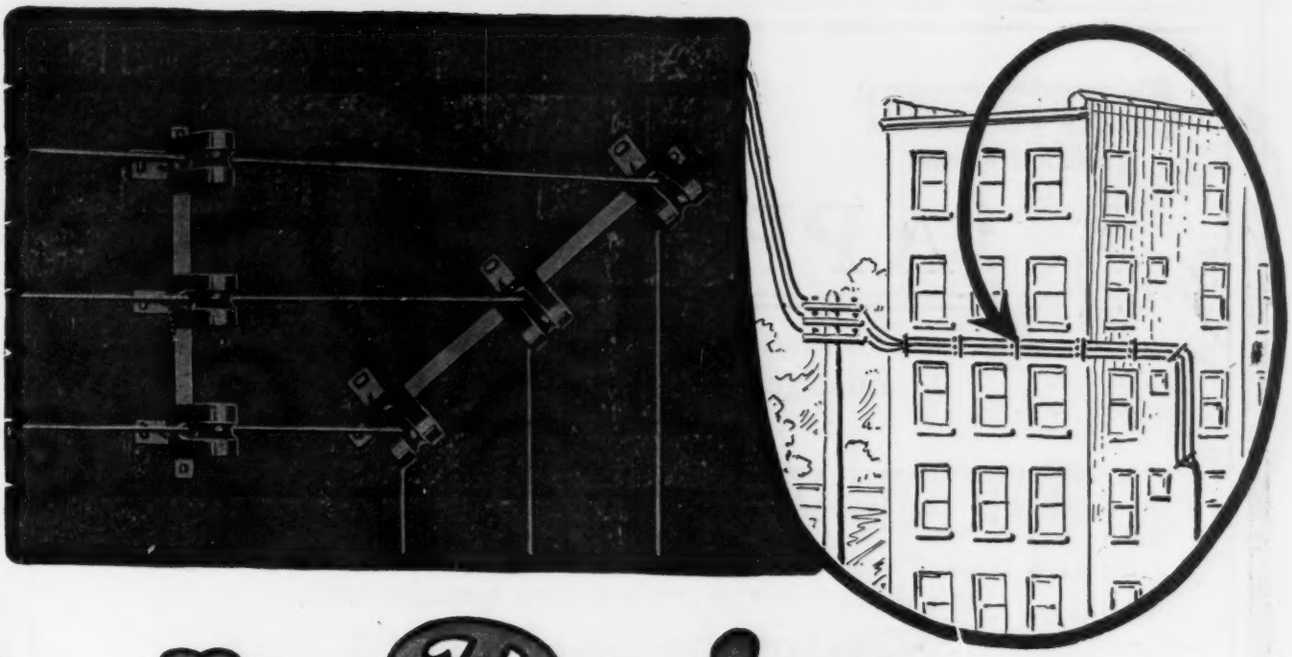
EN 10

"Chicago Pneumatic" Products

Pneumatic Tools
Electric Drills
Air Compressors
Oil, Gas and Steam Engines
Vacuum Pumps
Rock Drills

"CHICAGO PNEUMATIC"

Depend upon that name



The Peirce WIREHOLDER

Why do we call it a "Wireholder?"

Because it will hold your wires—just as it comes to you without any extras.

When you use house brackets, you must buy insulators and tie wires to use with them.

But the **Peirce Wireholder** *is a complete article.*

It comes with insulators assembled on it, and the insulators are designed to eliminate tie wires. The line wires are merely threaded through the holes.

The complete wireholder costs you about the same as the incomplete bracket.

You save the cost of

3 D. G. D. P. insulators	$ .17
3 Tie Wires	.13
Labor of assembling	.01
Labor of tying in	.02
	$ .33

and you get a more dependable job and a neater one. See your Jobber. He carries the **Wireholder** in six styles.

HUBBARD & COMPANY
PITTSBURGH, PA.

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

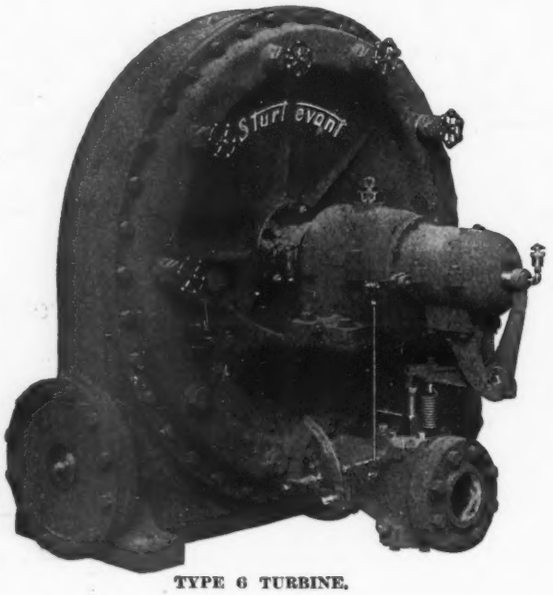
"APPROVED"

was written by the U. S. Navy and
Emergency Fleet Corporation
:: :: on the :: ::

Sturtevant (REG. U.S. PAT. OFF.) Steam Turbine

This without an alteration in our operating principle, allowing this department to produce on a quantity basis,

97% for the Government



TYPE 6 TURBINE.

This product of twelve years' development and research, embodies the Sturtevant quality of engineering practice. The solid rotor, integral nozzle and re-directing buckets give that simplicity and ruggedness that mean reliability.

Designed to operate Sturtevant fans and blowers, this turbine is equally efficient for driving pumps and generators.

Our new Turbine Catalog is now ready for distribution. Ask for No. 256-E.

B. F. STURTEVANT COMPANY

Hyde Park, Boston, Mass.
And all Principal Cities.

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

TEXACO TURBINE OILS

Recognition

Texaco Turbine Lubricants are not only recognized but recommended by leading manufacturers of turbines, large and small.

Performance

In plants of all sizes throughout the country, Texaco Turbine Lubricants are giving care-free lubricating service, keeping down operating expense, preventing stoppage, and saving money by the fact that they do not emulsify or cause corrosion of shafts and bearings.

Their dependability was strictly demonstrated by their use on men-o'-war and transports.

It was proven before then by continuous use of Texaco Turbine Oils in units for four or five years, and more.

Service

With the intensive experience and opportunity for study, our Texaco Lubrication Engineers can and will prescribe for you the Texaco Turbine Oil exactly suited to the needs of your particular units.

Start something. A line or two on a card or under your letter head will do it.

Now is the best time.

THE TEXAS COMPANY

Dept. L-3, 17 Battery Pl., N. Y. C.

New York Chicago Houston

Offices in Principal Cities

THERE IS A TEXACO LUBRICANT FOR EVERY PURPOSE

The 100% Electrician Says:

Approved by the Underwriters

"At Last I Have Found a Perfect Fixture Connector—

in all my experience I have never seen a connector that is as good in every way. With it I can make a connection easier, quicker, cleaner, better. It saves time—the screws *can't come out.* It is brass, giving high conductivity. It is simple—there are only three parts to it. It is safe and fool-proof—you can't get the wires in the wrong place."

A Connector Without a Fault

The Sherman Fixture Connector is the best fixture connector made. It is small and compact. It measures 1 inch in length—½ inch in width and ¼ inch in thickness. It will efficiently connect one or more small wires up to No. 12 solid, with a maximum of two No. 12's or three No. 14's in either end.

The Screws Can't Come Out With the Sherman Fixture Connector you don't have to pay a skilled workman for time spent in hunting for lost screws and for connectors that are thrown away because the screws cannot be found. Connectors at any price are cheaper than expensive labor. Time is money—Sherman Fixture Connectors save both.

Send for a FREE Sample of the Sherman Fixture Connector. This will give you an opportunity to try it in every way. Your sending for it will not obligate you in any way. Write Dept. A.

When the manufacturer of fixtures equips them with Sherman Fixture Connectors he improves his product and accommodates you. INSIST.

The quality of Sherman goods is never sacrificed to cheapness and useless expense is rigidly excluded as well. Sherman Fixture Connectors are sold by all progressive jobbers.

H. B. SHERMAN MANUFACTURING COMPANY

Battle Creek, Michigan

16 GOULDS PUMPS

in the Minnequa Coke Plant of the Colorado Fuel & Iron Co.

A striking illustration of the great popularity of Goulds Pumps with large industrial organizations is the pumping equipment of the Minnequa Works of the Colorado Fuel & Iron Co. at Pueblo. Sixteen "Goulds" are operated for various purposes.

Three Fig. 1128, size 12 x 12, Triplex Pumps pump tar over ovens; a Fig. 1694, size 8 x 10 Triplex pumps tar to cars; three Fig. 1694, size 7 x 10, Triplex pump liquor to tanks and stills; two Fig. 3030, Centrifugals size 5 S, lift water to tank; three Fig. 3011, Centrifugals, size 2, pump lime water to tanks; and three Fig. 3030, size 6 S, and two Fig. 3030, size 5 S, recirculate water over cooler towers and gas coolers.

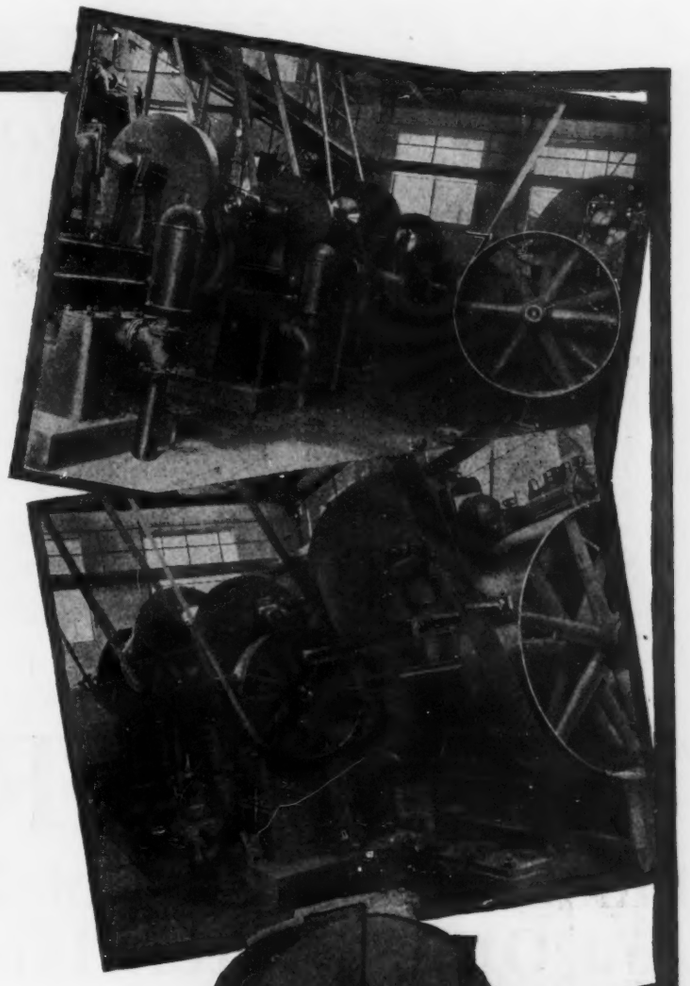
Goulds Pumps are built in many types and sizes—there is a Goulds Pump of remarkable efficiency for every pumping purpose.

Our Engineering Dept. is at your service for assistance on any pumping problem.

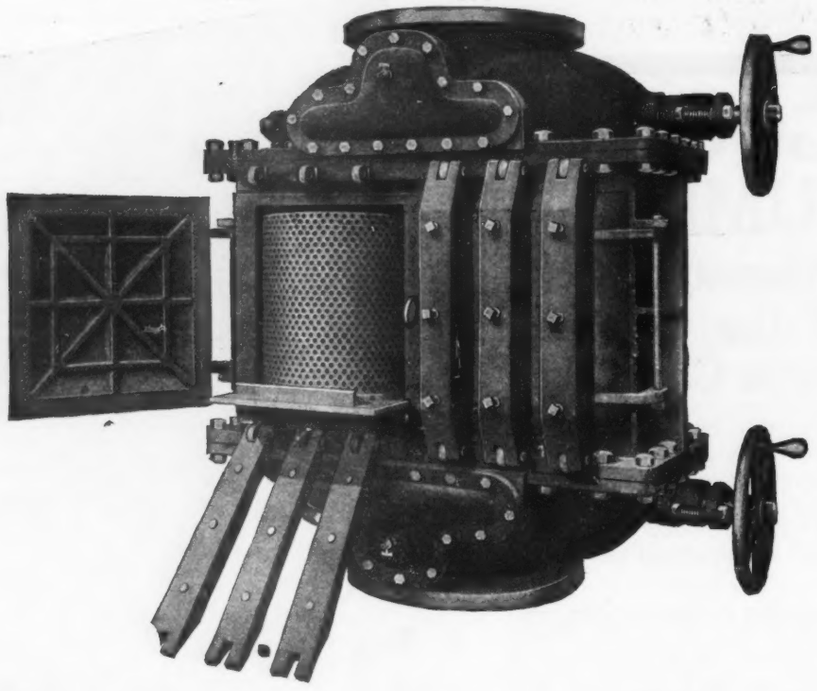
THE GOULDS MFG. COMPANY
SENECA FALLS, N. Y.

New York 16 Murray St.
Boston 68 Pearl St.
Chicago 12-14 S. Clinton St.
Philadelphia 111 North 3rd St.
Pittsburgh 636 Henry W. Oliver Bldg.
Atlanta 3rd National Bank Bldg
Houston 1001 Carter Bldg.

Every Goulds Pump is guaranteed to satisfactorily perform the specific work for which it is sold.



GOULDS PUMPS
FOR EVERY SERVICE



TWIN STRAINERS

Eliminate Clogging of Pumps, Condensers and Other Water-Handling Machinery

A TWIN STRAINER can't be clogged up, for when one basket is fouled with any sort of solid matter, a clean basket is cut into service by simply moving two valves.

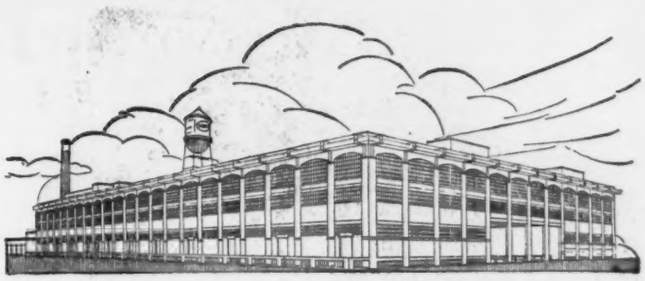
The dirty basket can then be lifted out, carried to a convenient place, cleaned, and then replaced in the Strainer—all this without interrupting the flow for an instant.

Twin Strainers are furnished in sizes ranging from 1 in. to 42 in. with perforations in the baskets to suit the service.

They can be installed in any position—horizontal or vertical. Full particulars in Bulletin "A" which will be sent on request.

ELLIOTT PRODUCTS
Condensers
Air Ejectors
Twin Strainers
Twin Filters
Feed Water Heaters
Steam Separators
Receiver Separators
Blow-Off Valves
Oil Filters
Steam Traps

ELLIOTT COMPANY
442 *Fifth Avenue, Pittsburgh, Pa.*



AMERICAN CAN CO., FACTORY, MAYWOOD, ILL.

INVESTIGATE BEFORE YOU INVEST

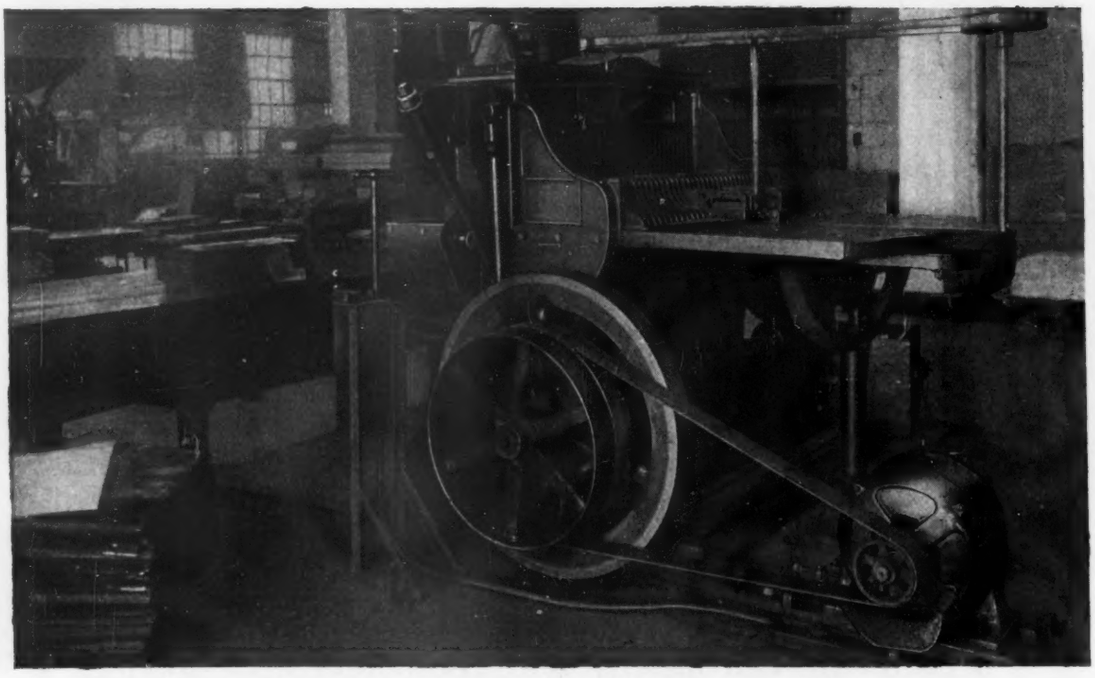
No matter how efficient in its own business, no organization can dispense with competent advice on its plant extensions, any more than a lawyer can dispense with a doctor when he is sick or a doctor dispense with a lawyer when he sues a client for his bill.

And pursuing the simile further, merely hiring any organization of engineers or contractors that makes plausible claims, without scrutinizing its credentials of ability, is as dangerous as hiring a lawyer or a doctor without regard to his record.

The Thompson-Starrett Company is not only competent to undertake your plant extensions, but its advice is constantly solicited and followed in the investigative stages of construction problems, by organizations which want specialized advice before they commit themselves to a contract.

Our Advice is as Good as Our Service

THOMPSON-STARRETT COMPANY
INDUSTRIAL CONSTRUCTION
NEW YORK
CHICAGO PITTSBURGH



Wagner 2-H.P. Squirrel Cage Motor Driving Paper Cutter in Printing Plant.

There Is Wisdom in Paying Enough

and getting what you want and pay for. But do you know what you want? Do you know that the most essential factor in motor buying is Quality? And to get **Quality** in motors you must pay enough.

Wagner, Quality Motors cost more than some other motors, but buying **Quality** is a dividend paying investment.

Wagner, Quality Motors are built in many types and sizes. If you do not know, a Wagner salesman can tell you the exact type of motor for your requirements.

Send for Bulletins 1174 and 1184.

Wagner Electric

Manufacturing Company, St. Louis, Mo.

510

Filtered Oil From An R-P Automatic Oil Circulating And Filtering System As Good As New Oil!

The tests described herewith were made by Cornell University on samples of oil taken from the R-P Automatic Oil Circulating and Filtering System in the McAlpin Hotel, New York. The oil tested has been in continuous service for **more than a year.**

Coefficient of Friction

A series of friction tests were made on a Thurston Railroad Lubricant Tester. The testing machine was run at a constant speed of about 360 R.P.M. and the load applied in increments of 75 pounds pressure per square inch. Readings of the coefficient of friction were made at ten minute intervals. The results are shown in the curves opposite (Fig.1.)

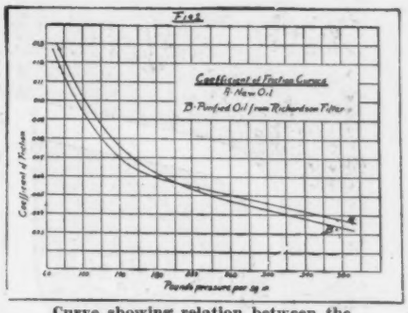
Temperature

The curves shown in Fig. 2 are the ones that will probably prove the most interesting to the operating engineer. It will be noted that the two curves in Fig. 6 are practically superimposed and in no case is the variation more than a few degrees, giving ample proof that the lubricating quality of the oil is practically unimpaired.

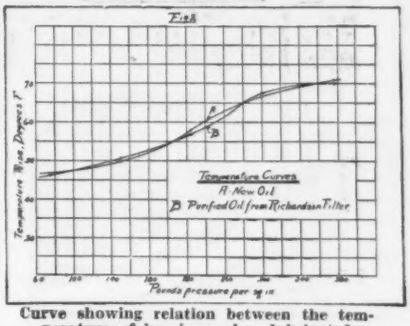
Readings of the temperature of the bearing were made at ten-minute intervals. The results of these tests are shown in the curves in Fig. 2. Fig. 2 shows the rise in temperature, that is, the difference between the temperature of the bearing and of the room.

Viscosity

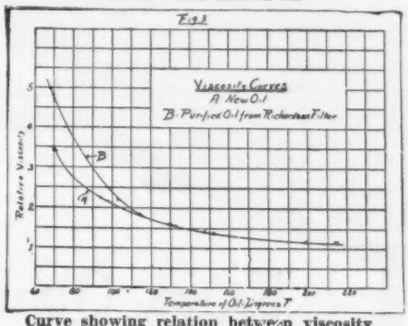
Tests of the new and filtered oil were also made in an Olsen viscosimeter. The results of these tests are shown in Fig. 3. From the data it is evident that oil gains in specific gravity through constant use. This is what one would naturally expect inasmuch as the oil in passing through the bearings had had some of its more volatile constituents driven off. The viscosity curves also show that as oil is used over and over again in an oiling system, it actually gains in body, provided a filter is used which thoroughly removes entrained water.



Curve showing relation between the coefficient of friction of new and filtered oil



Curve showing relation between the temperature of bearings when lubricated with new and filtered oil



Curve showing relation between viscosity of new and filtered oil

Laboratory Tests of New and Filtered Oil

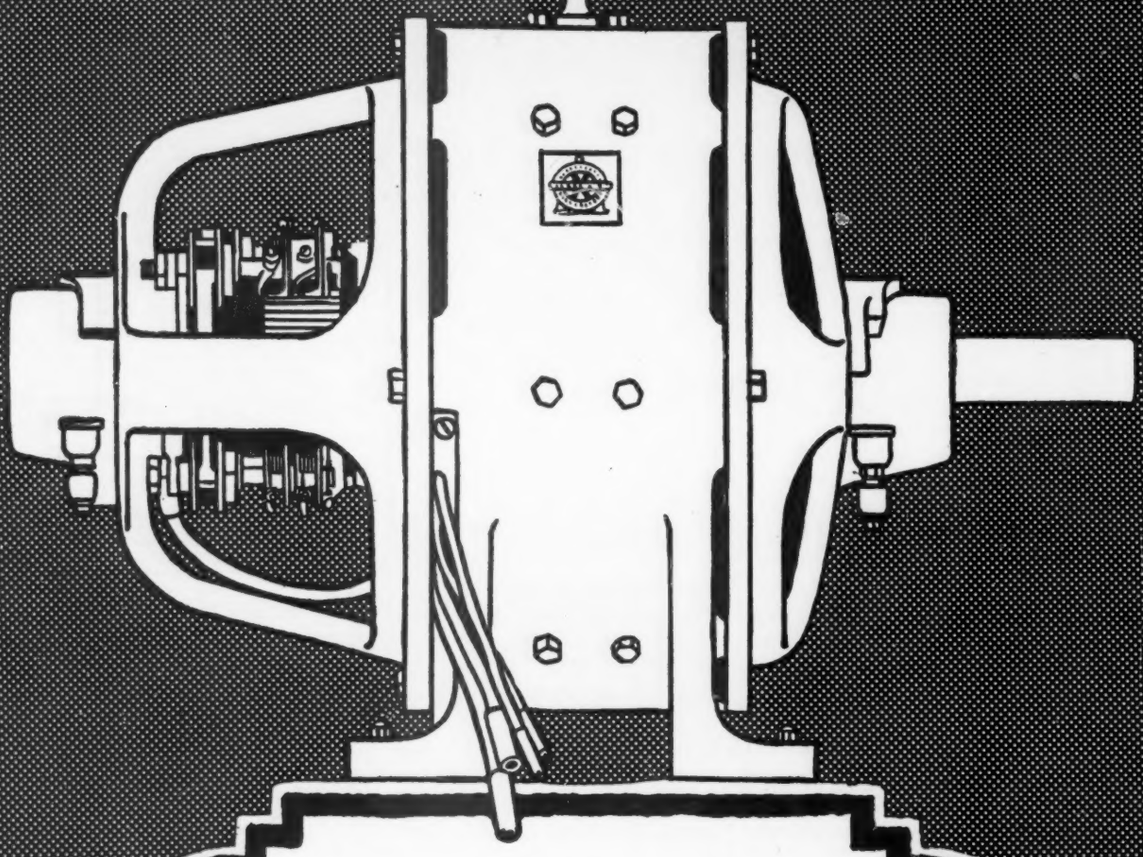
Sample "A"—New Oil
Color—medium red, translucent.
Flash point 410 degrees (open cup).
Burning point—460 degrees F. (open cup).
Specific gravity at 60 degrees F. water as 1-.895.

Sample "B"—Purified Oil from Peterson Filter
Color—very dark red, opaque.
Flash point—410 degrees F. (open cup).
Burning point—440 degrees F. (open cup).
Specific gravity at 60 degrees F. water as 1-.903.

In hundreds of plants, R-P Automatic Oil Circulating and Filtering Systems are making remarkable savings. Every engineer should be thoroughly familiar with Bulletin M-25, which describes their application in detail. Drop a postal for your copy today.

THE RICHARDSON-PHENIX CO.
LUBRICATION ENGINEERS AND MANUFACTURERS
WORKS-127 RESERVOIR AVE. MILWAUKEE, WIS.

Type T Heavy Duty
RELIANCE MOTORS
Direct Current



Extra Quality and Extra Quantity

The 35 electrical engineers who co-operated with us in the design of Type T motors have under their care installations of 300 to 3000 motors. From years of experience in their repair shops they have learned where extra quality and strength would mean better motor service.

It was such experience that guided us in the building of a motor that would stay on the job longer and be in the repair shop less. The story of how better material and more of it is used in buiding Type T motors is told in Bulletin 2014 with 39 illustrations.

Reliance Electric & Engineering Co.

1046 Ivanhoe Road, Cleveland, O.

Branches: Boston, New York, Philadelphia, Pittsburgh, Chicago

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used by the Electrical Industry with Names of Manufacturers and Distributors

Air Compressors.
Allis-Chalmers Mfg. Co.
General Electric Co.
Hartford Machine Screw Co.
Worthington Pump & Machy. Corpn.

Air Washers and Coolers.
Spray Engrg. Co.

Aluminum.
Aluminum Co. of America.

Ammeters, Voltmeters.
(See Instruments, Electrical).

Anchors, Guy.
Crouse-Hinds Co.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Arches, Boiler
Green Engineering Co.

Armature Repair Machinery
Electric Service Supplies Co.

Asbestos Lumber
Johns-Manville Co., H. W.

Batteries, Dry Cell.
Manhattan Elec'l Supply Co.
Western Elec. Co.

Batteries, Storage.
Edison Storage Battery Co.
Electric Storage Battery Co.

Battery Charging Apparatus.
Cutler-Hammer Mfg. Co.
General Elec. Co.
St. Louis Elec'l Wks.
Weshe Electric Co., B. A.

Bearings, Ball.
Norma Co. of America.

Belt Fasteners
Flexible Steel Lacing Co.

Belt Lacing
Flexible Steel Lacing Co

Belting, Leather
Ladew Co., E. R.

Blowers, Electric
Sturtevant Co., B. F.

Blowers, Steam Driven.
Green Fuel Economizer Co.
Terry Steam Turbine Co.

Boilers, Steam.
Babcock & Wilcox Co.
Bigelow Co.
Edge Moor Iron Co.

Bolts, Expansion.
Hubbard & Co.

Bond Testers.
Roller-Smith Co.

Books, Technical.
McGraw-Hill Company, Inc.

Boosters.
Crocker-Wheeler Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Triumph Electric Co.
Wesche. Elec. Co., B. A.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse.
Crouse-Hinds Co.
General Electric Co.
Johns-Mannville Co., H. W.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.

Boxes, Junction and Outlet.
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.
D. & W. Fuse Co.
General Electric Co.
National Metal Molding Co.
Sprague Electric Works.

Boxes, Meter and Service.
Crouse-Hinds Co.
General Elec. Co.
Johns-Mannville Co., H. W.
Metropolitan Eng'g Co.

Brackets and Pins, Metal.
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Pittsburgh Transformer Co.

Brushes, Dynamo.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.

Buckets, Clamshell
Blaw-Knox Co.

Buckets, Excavating, Motor Driven.
Blaw-Knox Co.
Hayward Co.

Buildings, Steel.
Blaw-Knox Co.
Delta Star Elec. Co.
Milliken Bros. Mfg. Co.

Bus Bar Supports
Delta Star Electric Co.

Bushings.
Crouse-Hinds Co.
National Fibre & Insulation Co.
National Metal Molding Co.
Siemon Hard Rubber Corp.

Cabinets, Panel Board
Crouse-Hinds Co.

Cable End Bells
Electrical Engineers Equipment Co.

Cable Racks.
Hubbard & Co.
Metropolitan Eng'g Co.

Cabling Machinery.
American Ins. Machinery Co.
New England Butt Co.

Carbon Brushes.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.

Cars, Coal & Ash Handling.
Easton Car & Const. Co.

Castings
Triumph Electric Co.

Castings, Die.
Acme Die Casting Corp.
Doehler Die-Casting Co.
Precision Castings Co.

Chains, Silent Driving
Morse Chain Co.

Chains, Silent Power Transmission
Morse Chain Co.

Circuit Breakers.
Automatic Reclosing Circuit Breaker Co.
Condit Elec. Mfg. Co.
Cutter Co.
General Electric Co.
Industrial Controller Co.
Palmer Elec. & Mfg. Co.
Roller-Smith Co.
Sangamo Elec. Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Clamps, Cable Supporting.
Matthews & Bro., Inc., W. N.

Clamps, Ground Connections.
Condit Elec. Mfg. Co.
General Electric Co.

Clamps, Guy.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Clamps, Insulator.
Electrical Engineers Equipment Co.

Cleats.
Blake Signal & Mfg. Co.
Imperial Porcelain Works.
National Metal Molding Co.

Climbers, Linemen's
Buckingham, W. H.

Clips, Cable
Condit Elec. Mfg. Co.
Hubbard & Co.

Clips, Testing
Mueller & Co., R. S.

Clusters
Hubbell, Inc., Harvey

Clutches, Magnetic.
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery.
Blaw-Knox Co.
Green Engineering Co.
Hayward Co.
Northern Engineering Works
Pulverized Fuel Equipment Corp.

Coil Winding Tools
Electric Service Supplies Co.

Coils
Coto-Coil Co.
Dudlo Mfg. Co.

Coils, Armature, Field
D & W Fuse Co.
Independent Lamp & Wire Co.

Coils, Choke.
Delta Star Elec. Co.
General Electric Co.

Commutator Stones
Ideal Commutator Dresser Co.

Commutators.
Cameron Electric Mfg. Co.

Compounds, Commutator.
McLennan Co., K.

Condensers.
Elliott Company
Griscom-Russell Co.
Manistee Iron Works
Wheeler Condenser & Eng. Co.
Worthington Pump & Machy. Corpn.

Conduit Bends.
Fibre Conduit Co.

Conduit Fittings.
Crouse-Hinds Co.
Fibre Conduit Co.
Sprague Electric Works.

Conduits, Interior.
American Circular Loom Co.
National Metal Molding Co.
Sprague Electric Works.

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Fibre Conduit Co.
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Westinghouse Elec. & Mfg. Co.

Connectors and Terminals.
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Electric Service Supplies Co.

Contracting Engineers
Thompson-Starrett Co.

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Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

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American Bridge Co.
Green Engineering Co.

Cooling Ponds, Spray.
Spray Engrg. Co.

Cord Adjusters.
American Vul. Fibre Co.
National Fibre & Insulation Co.

Cord, Arc Lamp.
Samson Cordage Works.

Cord, Flexible.
Belden Mfg. Co.
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Cord, Trolley.
Samson Cordage Works.

Couplings, Flexible.
Smith-Serrell Co., Inc.

Crane Motors.
Sprague Electric Works.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
American Bridge Co.
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Northern Engineering Works

Cross Arms.
American Bridge Co.
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Western Electric Co.

Cutouts.
D & W Fuse Co.
Condit Elec. Mfg. Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g. Co.

Dealers' Machinery
(See Searchlight Section and Second-Hand Apparatus.)

Draft, Mechanical.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Drills, Brick.
Hubbard & Co.

Dynamos and Motors.
Allis-Chalmers Mfg. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
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Roth Bros. & Co.
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Sturtevant Co., B. F.
Triumph Electric Co.
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Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Economizers, Fuel.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

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Elec. Controller & Mfg. Co.
Ohio Elec. & Controller Co.
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Ambrine Laboratories

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Sterling Engine Co.
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McIntosh & Seymour Corp.
Midwest Engine Co.
Worthington Pump & Machy. Corpn.

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Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng. Co.

Evaporators, Water
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Hayward Co.

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Kimble Elec. Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Sprague Electric Works.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.

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Terry Steam Turbine Co.

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Elliott Co.
Matthews & Bro., Inc., W. N.

Feed Water Heaters
Elliott Co.
Griscom-Russell Co.

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American Vul. Fibre Co.
Continental Fibre Co.
Fibre Conduit Co.
National Fibre & Insulation Co.

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Elliott Company
Richardsor-Phenix Co

Filters, Water
Blackburn-Smith Corp
Elliott Company
Griscom-Russell Co.
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Furnace Equipment, Water Cooled
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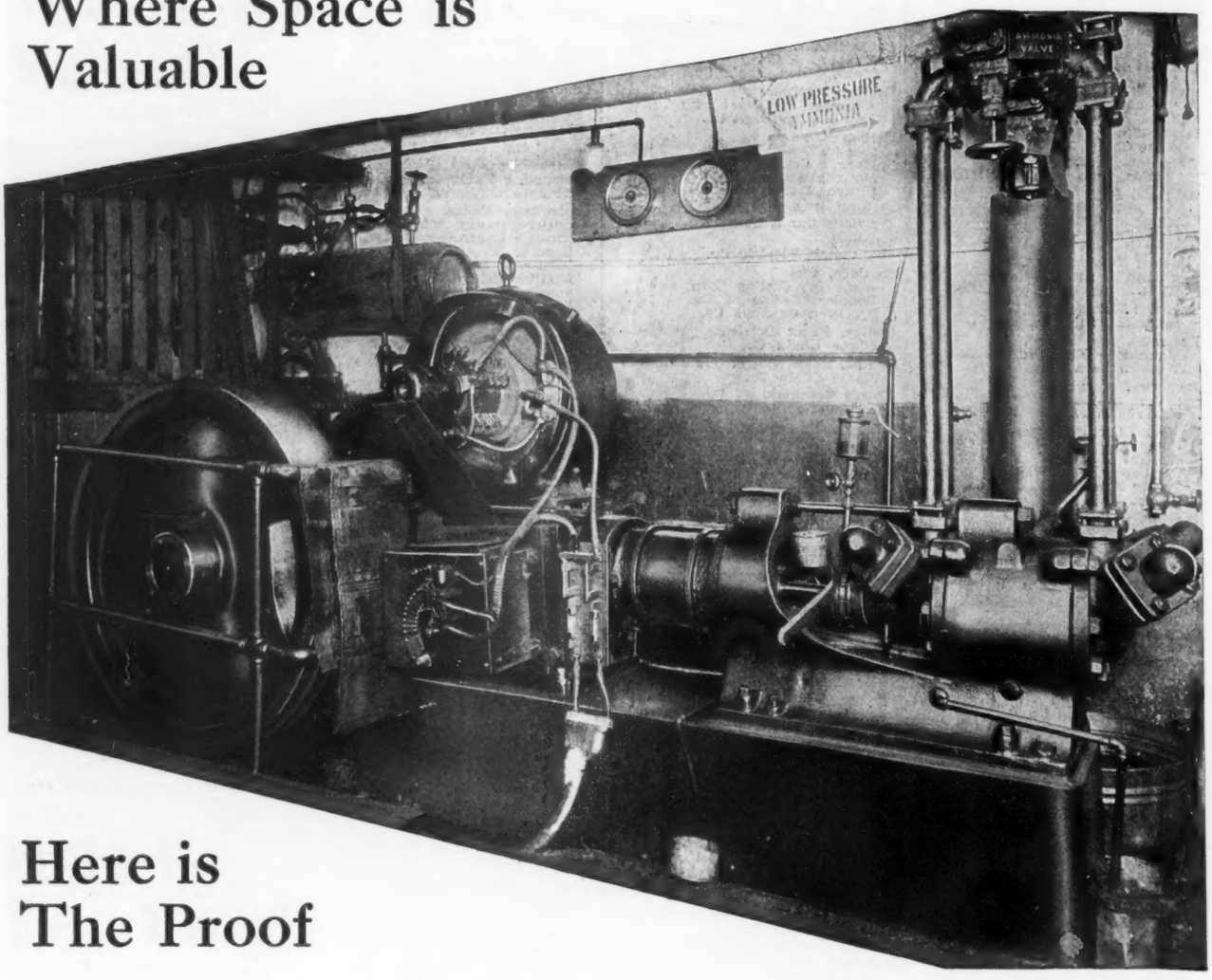
Furnaces, Electric.
Pittsburgh Furnace Co.

Furnaces, Pulverized Coal
Pulverized Fuel Equipment Corp.

"OVER THE TOP"

A PEERLESS DRIVE

Where Space is Valuable



Here is The Proof

This problem of lack of space was solved by mounting this 25 hp. PEERLESS multipolar motor *directly on top* of the pump, this is proof of the ability of PEERLESS motors to meet any requirement, however unusual. The inbuilt quality, rugged construction and the perfectly balanced armature combine to make a highly efficient drive, free from all vibration and occupying no additional floor space, which, as in this case, is often a valuable consideration.

It is in unusual applications such as this one that PEERLESS motors have earned their distinction and firmly established their reputation for efficiency, adaptability and economy of operation under all conditions.

It has been our constant aim to maintain PEERLESS products at the highest degree of electrical and mechanical perfection humanly possible and render that "PEERLESS SERVICE" which the purchaser pays for and has a right to expect.

Let us help *you* solve your motor problems.

Bulletins promptly on request.

The Peerless Electric Co.

Warren, Ohio

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San Francisco—The Garland Affolter Co.
Seattle—The Garland Affolter Co.
St. Louis—L. M. Sperry—917 Pine St.

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Delta Star Elec. Co.
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Johns-Mannville Co., H. W.
Metropolitan Eng'g. Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Western Elec. Co.

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Chicago Fuse Mfg. Co.
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Economy Fuse & Mfg. Co.

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Foxboro Co., The.
Precision Instrument Co.

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Matthews & Bro., Inc., W. N.

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Barnes & Irving, Inc.

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Condit Elec. Mfg. Co.
Hubbard & Co.

Hardening, Case Hardening and Tempering
Edison Lamp Works

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American Bridge Co.

Headlights, Acid and Incadescent
Crouse-Hinds Co.

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General Electric Co.
Simplex Electric Heating Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Heating and Ventilating Systems
Sturtevant Co., B. F.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Northern Engineering Wks.
Sprague Electric Works.

Indicators, Sight Flow.
Richardson-Phenix Co.

Indicators, Speed.
Biddle, James G.
Roller-Smith Co.

Industrial Railways and Cars
Easton Car & Const. Co.

Instrument Transformers.
General Elec. Co.
Weston Electrical Instrument Co.

Instruments, Electrical.
Graphic.
Biddle, James G.
Bristol, Co.
General Electric Co.
Sangamo Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Indicating.
General Electric Co.
Precision Instrument Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.
Integrating.
Biddle, James G.
Duncan Elec. Mfg. Co.
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Repairing and Testing.
Illinois Testing Laboratories
Scientific and Testing.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Eng'g. Co.
Weston Elec. Instrument Co.

Insulating Machinery.
American Ins. Machinery Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Imperial Porcelain Works.
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Pittsburg H. V. Ins. Co.
Compounds, Paints and Varnishes
Garfield Mfg. Co.
General Bakelite Co.
Mitchell-Rand Mfg. Co.
Redmanol Chemical Products Co.
Standard Paint Co.
Fibre.
Amer. Vulcanized Fibre Co.
Continental Fibre Co.
Lava.
American Lava Co.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Engene.
Silk.
Ryle & Co., Wm.
Slate
Mitchell-Rand Mfg. Co.
New York Insulated Wire Co.
Okonite Co., The

Insulating Paper.
Johns-Mannville Co., H. W.
National Fibre & Insulation Co.

Insulator Pins.
Hubbard & Co.

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Matthews & Bros., Inc., W. N.

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Hygrade Lamp Co.
Independent Lamp & Wire Co.
National Lamp Works
Western Elec. Co.
Westinghouse Lamp Co.
Whitelite Elec. Co.

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Miniature Incandes. Lamp Corp.

Lava.
(See Insulating Material, Lava.)

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(See Dynamos & Motors.)

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Manistee Iron Works
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Worthington Pump & Machy. Corpn.

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Worthington Pump & Machy. Corpn.

Pumps, Hydraulic
Worthington Pump & Machy. Corpn.

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Goulds Mfg. Co.
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Worthington Pump & Machy. Corpn.

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Worthington Pump & Machy. Corpn.

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General Elec. Co.

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(See Instruments, Electrical.)

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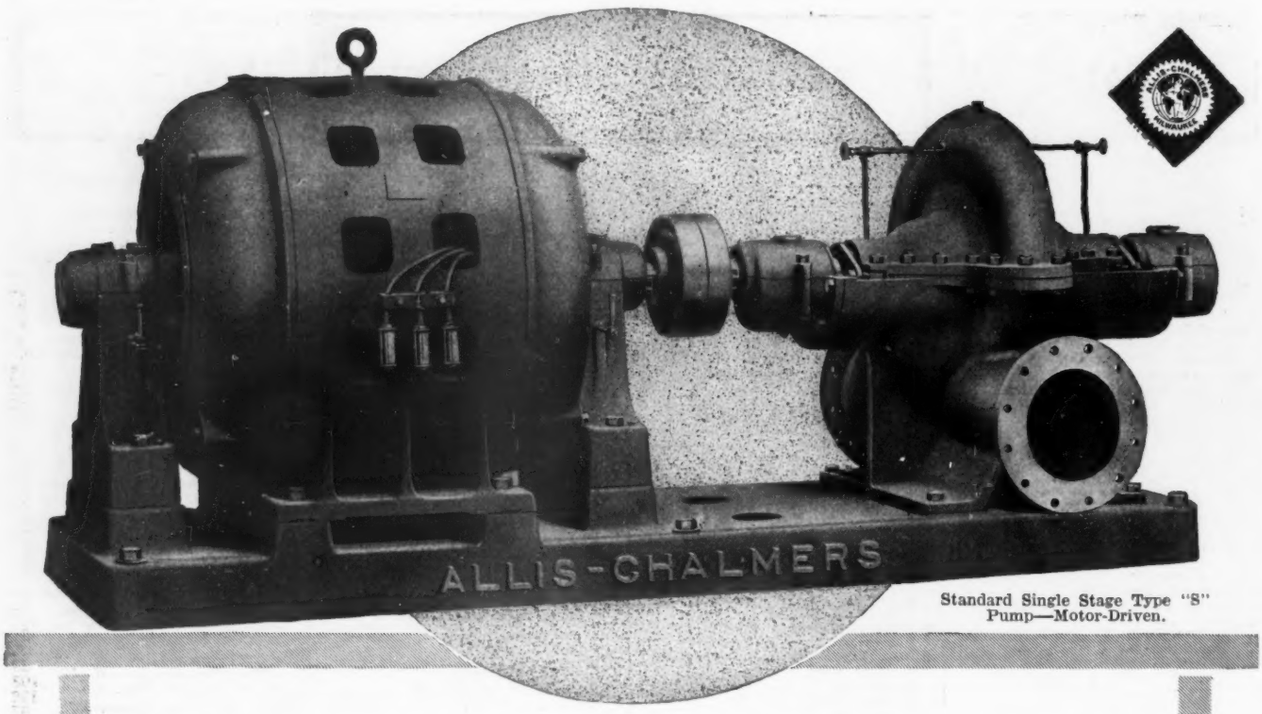

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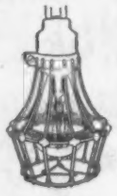

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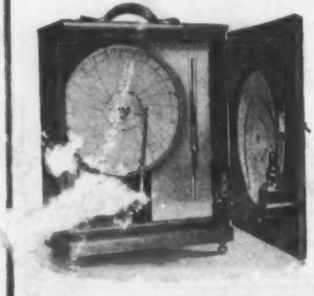

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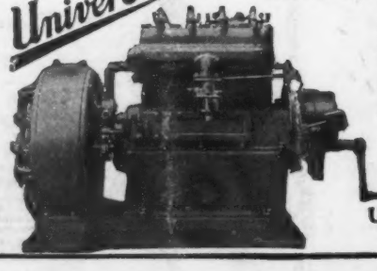

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